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FIELD SAMPLING AND ANALYTICAL PLAN
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
KOPPERS SOUTH CAVALCADE SITE
HOUSTON, TEXAS

OCTOBER 1985

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Koppers Company, Inc.
Pittsburgh, Pennsylvania 15219

KOPPERS

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HOUSTON, TEXAS

Approved by *S. M. Tymniak* Date *Oct. 14, 85*
Koppers Manager, Previously Operated Properties

001898

Approved by *John Cochran* per Date *10/23/85*
EPA Regional Site Project Officer the letter from L. Wright to
M. Tymniak, dated October 23, 1985



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

October 23, 1985
S. Michael Tymiak, P.E.
Manager, Previously Operated Properties
Environmental Resources
Koppers Company Inc.
1940 Koppers Building
436 Seventh Avenue
Pittsburgh PA 15219

Re: Koppers South Cavalcade site

Dear Mr. Tymiak:

The EPA has reviewed and approved Koppers' Sampling and Analytical Plan (SAP) for the South Cavalcade site, Kopper's cover letter dated October 9, 1985. EPA approval is contingent upon the following changes to the SAP. These changes are the result of a mutual agreement between EPA and Koppers as discussed by Mr. Cochran and Mr. Campbell in their telephone conversation of October 23, 1985.

- 1) Trip Blanks - When sampling surface water, surface sediment and groundwater, (Sections 2.5, 3.5 and 5.6) one trip blank shall be "collected" per media per day. If surface water and surface sediment samples are collected on the same day, then one trip blank shall suffice for both media. Trip blanks shall be analyzed for Volatile Organics only.
- 2) Field Blanks - Field blanks for soil analysis (Section 4.5) are dropped from the sampling schedule. Per page 17 of the User's Guide to the Contract Laboratory Program, October 1984, soil blanks will not be collected in the field.
- 3) Analysis of Duplicate Soil Samples - The footnote (a) under Section 4.5 shall be deleted and the 36 (or correspondingly appropriate number of) duplicate samples referenced in Section 4.5 shall be tested using the Total Petroleum Hydrocarbons surrogate methodology. Further, an additional 10% of the samples specified for full scale laboratory analysis (Section 4.6) shall also be analyzed as duplicates using the methodologies specified in Section 4.6. The samples analyzed in duplicate under the surrogate program need not be the same samples that are analyzed by full laboratory methodology.

001899

- 4) Drilling Methodology - The full scale drill rig soil samples (Section 4.2) shall be collected using dry hollow stem auger techniques. The monitoring wells shall also be installed using dry hollow stem auger techniques (Section 5.3).
- 5) Sample Bottles for Archived Samples - The sample bottles for the archived soil samples must be detergent washed and heat dried. Detergent washed bottles are adequate because; a) archived samples will be compromised anyway because of the holding times, b) possible contaminants from the detergent wash are different from the possible site contaminants, and c) archiving the samples is above and beyond the call of duty and this extra effort need not be unduly burdensome.

Should you have any questions please contact Mr. Cochran at (214)-767-9763.

Sincerely yours,


Larry Wright
Chief, Superfund Enforcement

cc: C. Faulds, TWC

001900

TABLE OF CONTENTS

	Page
 LIST OF TABLES AND FIGURES	
1.0 INTRODUCTION	1-1
1.1 Background	1-1
1.2 Site Description and History	1-2
2.0 SURFACE WATER CHARACTERIZATION	2-1
2.1 Sampling Frequency	2-1
2.2 Sampling Locations	2-1
2.3 Sampling Methodology	2-3
2.4 Sample Containers and Preservatives	2-3
2.5 Sampling Identification/Numbering	2-4
2.6 Field Analysis	2-7
2.7 Laboratory Analysis	2-7
2.8 Proposed Sampling Team	2-9
3.0 SURFACE SEDIMENT CHARACTERIZATION	3-1
3.1 Sampling Frequency	3-1
3.2 Sampling Locations	3-1
3.3 Sampling Methodology	3-1
3.4 Sample Containers and Preservatives	3-3
3.5 Sample Identification and Numbering	3-4
3.6 Laboratory Analyses	3-4
3.7 Proposed Sampling Team	3-5
4.0 SUBSURFACE SOIL CHARACTERIZATION	4-1
4.1 Sampling Locations	4-1
4.2 Sampling Methodology	4-6
4.3 Screening Analyses	4-7
4.4 Sample Containers and Preservatives	4-8
4.5 Sample Identification/Numbering	4-8
4.6 Laboratory Analyses	4-9
4.7 Proposed Sampling Team	4-25
5.0 SHALLOW AQUIFER GROUNDWATER INVESTIGATION	5-1
5.1 Water Level Measurement and Sampling Frequency	5-1
5.2 Sampling Locations	5-2

5760A

001901

TABLE OF CONTENTS (Cont'd)

	Page
5.3 Observation Well Installation	5-2
5.4 Sampling Methodology	5-5
5.5 Sample Containers and Preservatives	5-9
5.6 Sample Identification/Numbering	5-9
5.7 Aquifer Properties Analysis	5-10
5.8 Field Analyses	5-10
5.9 Laboratory Analyses	5-10
5.10 Proposed Sampling Team	5-15
6.0 DEEPER GROUNDWATER INVESTIGATION	6-1
6.1 Water Level Measurements and Sampling Frequency	6-1
6.2 Sampling Locations	6-1
6.3 Observation Well Installation	6-3
6.3.1 Soil Sampling Methodology	6-4
6.3.2 Screening Analysis of Soils	6-4
6.3.3 Laboratory Analysis of Soils	6-5
6.3.4 Soil Sample Containers and Preservatives	6-5
6.3.5 Soil Sample Identification/Numbering	6-6
6.4 Observation Well Monitoring	6-7
6.4.1 Groundwater Sampling Methodology	6-7
6.4.2 Field Analysis of Groundwater Samples	6-7
6.4.3 Laboratory Analysis of Groundwater Samples	6-7
6.4.4 Groundwater Sample Containers and Preservatives	6-10
6.4.5 Groundwater Sample Identification/Numbering	6-10
6.5 Proposed Sampling Team	6-11
7.0 NONSOIL MATERIALS INVESTIGATION	7-1
7.1 Methodology	7-1
7.2 Sampling Location	7-1
7.3 Analyses	7-1
7.4 Proposed Sampling Team	7-2

001902

TABLE OF CONTENTS (Cont'd)

	Page
8.0 AIR QUALITY INVESTIGATION	8-1
8.1 Sampling Frequency	8-1
8.2 Sampling Methodology	8-1
8.3 Sample Containers and Preservatives	8-1
8.4 Sample Identification and Numbering	8-2
8.5 Analysis	8-2
8.6 Proposed Sampling Team	8-2
9.0 GEOPHYSICAL SURVEYING	9-1
9.1 Sampling Locations	9-1
9.2 Survey Methodology	9-2
9.3 Proposed Sampling Team	9-3

APPENDICES

Appendix I - SOP 7120 Surface Water Sampling
Appendix II - SOP 7600 Decontamination
Appendix III - Flow Measurement by Float Method
Appendix IV - Federal Regulation 40 CFR, Part 265, Subpart I
Appendix V - SOP 7140 Lake and Stream - Bottom Sediment Sampling
Appendix VI - SOP 7315 Operation/Calibration HNu Photoionization Analyzer
Appendix VII - SOP 7115 Subsurface Soil Sampling
SOP 7210 Rock-Core Drilling
SOP 7211 Logging of Rock Cores
Appendix VIII - SOP 7130 Groundwater Sample Collection from Monitoring Wells
Appendix IX - SOP 7220 Monitoring-Well Construction and Installation
Appendix X - Operating Procedures for Sampling of Organic Vapors and Airborne Particulates
Appendix XI - SOP 7510 Packaging and Shipment of Samples
Appendix XII - Method 120.1 Specific Conductance
Method 150.1 pH
Method 170.1 Temperature
Method 360.1 Dissolved Oxygen

001903

LIST OF TABLES

		Page
2-1	Sample Identification Numbers for Surface Water Samples Collected at the South Cavalcade Street Site	2-5
3-1	Sample Identification Numbers for Surface Sediment Samples Collected at the South Cavalcade Street Site	3-6
4-1	Sample Identification Numbers for Subsurface Soil Samples Collected at the South Cavalcade Street Site	4-10
5-1	Sample Identification Numbers for Soil Samples Collected from Shallow Aquifer Observation Well Installation at the South Cavalcade Street Site	5-6
5-2	Sample Identification Numbers for Shallow Aquifer Groundwater Samples Collected at the South Cavalcade Street Site	5-12
6-1	Sample Identification Numbers for Soil Samples Collected from Deeper Aquifer Observation Well Installation at the South Cavalcade Street Site	6-9
6-2	Sample Identification Numbers for Deeper Aquifer Groundwater Samples Collected at the South Cavalcade Street Site	6-12
8-1	Sample Identification Numbers for Air Samples Collected at the South Cavalcade Street Site	8-3

001904

LIST OF FIGURES

		Page
1-1	Site Location Map	1-3
2-1	Proposed Sediment and Surface Water Sampling Sites	2-2
3-1	Proposed Sediment and Surface Water Sampling Sites	3-2
4-1	Proposed Subsurface Boring Areas	4-2
5-1	Existing and New Observation Well Locations for Shallow Aquifer Groundwater Sampling	5-3
6-1	Existing and New Observation Well Locations for Deeper Aquifer Groundwater Sampling	6-2

001905

1.0 INTRODUCTION

1.1 Background

A remedial investigation of the former Koppers/South Calvalcade Street site is being conducted to characterize the nature and extent of contamination of soils, groundwater, and surface water and its threat to human health and the environment. The information collected during the remedial investigation will be used in a feasibility study to identify, evaluate and select the most cost effective remedial alternative.

The Field Sampling and Analytical Plan for Koppers/South Cavalcade site details the sampling and analytical requirements and procedures for performing the RI/FS. The following field activities are addressed in this plan:

- (1) Surface water characterization
- (2) Surface sediment characterization
- (3) Subsurface soil chracterization
- (4) Shallow aquifer groundwater investigation
- (5) Deeper aquifer groundwater investigation
- (6) Nonsoil materials investigation
- (7) Air quality investigation
- (8) Geophysical surveying

For each field activity, this plan addresses the following topics, where applicable:

- o sampling frequencies
- o sampling locations
- o sampling methodology
- o sample containers and preservatives
- o field analyses
- o sample identification/numbering

1.2 Site Description and History

The South Cavalcade site is currently bounded by the Houston Belt Terminal Railroad tracks to the east, Cavalcade Road to the north, Missouri Pacific railroad tracks to the west, and Collingsworth Road to the south (see Figure 1-1). The site currently consists of approximately 55 acres on a parcel of land 1 1/2 miles south west of the intersection between Loop 610 and U.S. Route 59 (Eastex Freeway).

The majority of the site area was formerly used to treat wood products with creosote and other wood preservative products. From 1911 to 1939 the plant was operated by the National Lumber and Creosoting Company. This operation consisted of a production facility on the south central portion of the site and "dripping" and drying areas toward the center and northern areas of the site. Koppers company purchased the operation in 1940 and constructed a coal tar distillation facility in the southeast corner of the site. Numerous ponds, tanks, and lagoons existed on the site. In 1962, Koppers closed the operation, removed all plant buildings and covered the site with soil. Currently, three palletized trucking firms and a leasing company are located within the site boundary. In the early 1980's the Harris County Metropolitan Transit Authority became interested in the site for use as a combined railyard, shop and station for a proposed light rail system.

A routine geotechnical investigation revealed several localized areas to be contaminated with creosote waste products. A subsequent contaminant survey performed by Camp Dresser and McKee, Inc. (CDM) indicated the presence of soil and shallow groundwater contaminants including polynuclear aromatic hydrocarbons (PAH), light aromatics, phenolics, and heavy metals. Many of these chemical components of the coal tar and creosote oil contamination are recognized as toxic and/or potential carcinogens. In 1983, the site was handed over to the US EPA and placed on the National Priority List (NPL).

001907

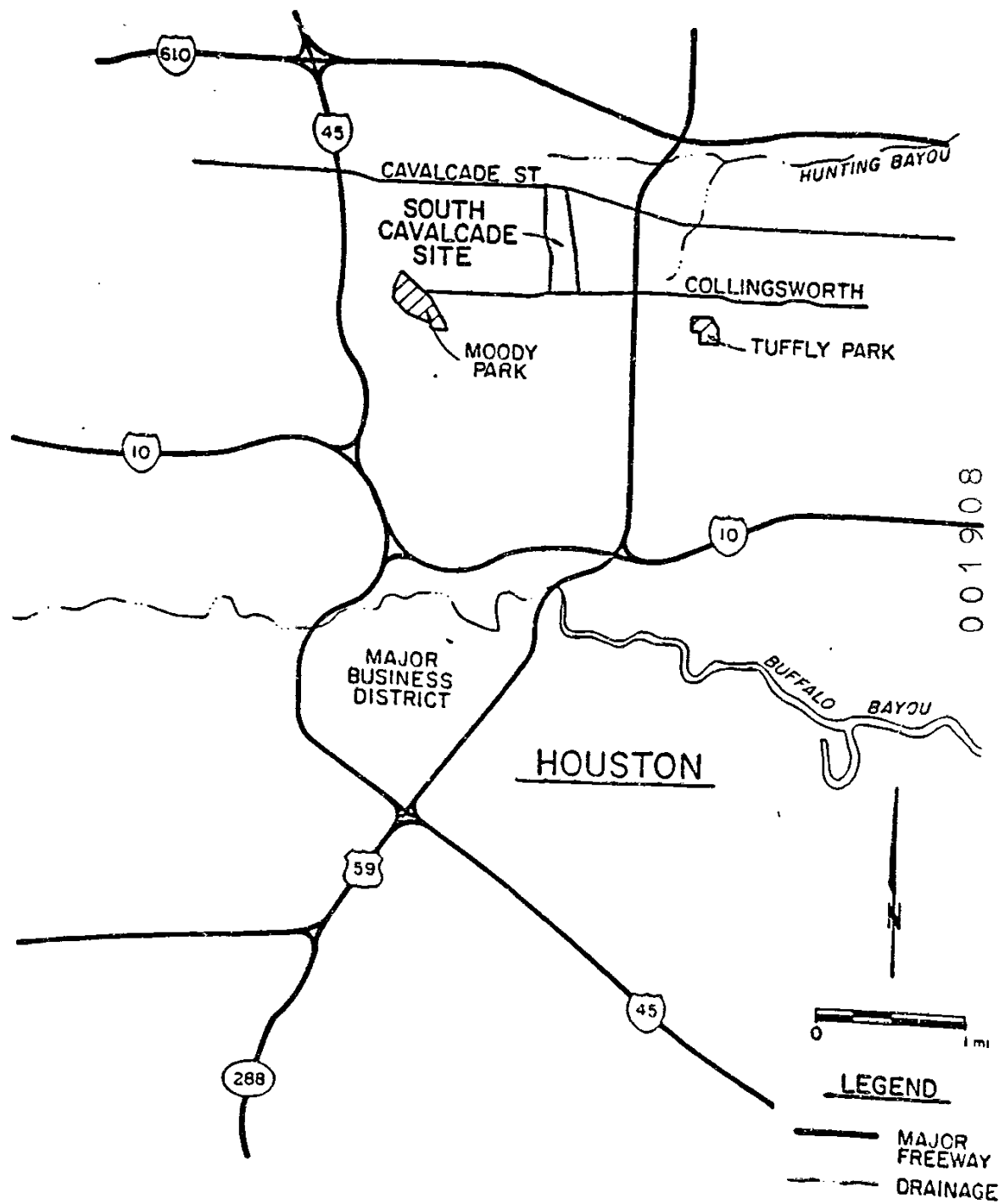


Figure 1-1
Site Location Map

2.0 SURFACE WATER CHARACTERIZATION

Surface water samples will be collected from drainage ditches in order to obtain information on the quality of surface water runoff leaving the site.

2.1 Sampling Frequency

Runoff shall be sampled twice during the field sampling program. For each sampling round two samples shall be taken at each location when runoff begins. One sample shall contain only water (i.e., no sediment or surface film), the other sample shall include surface film if present. If no surface film exists, omit the sample.

2.2 Sampling Locations

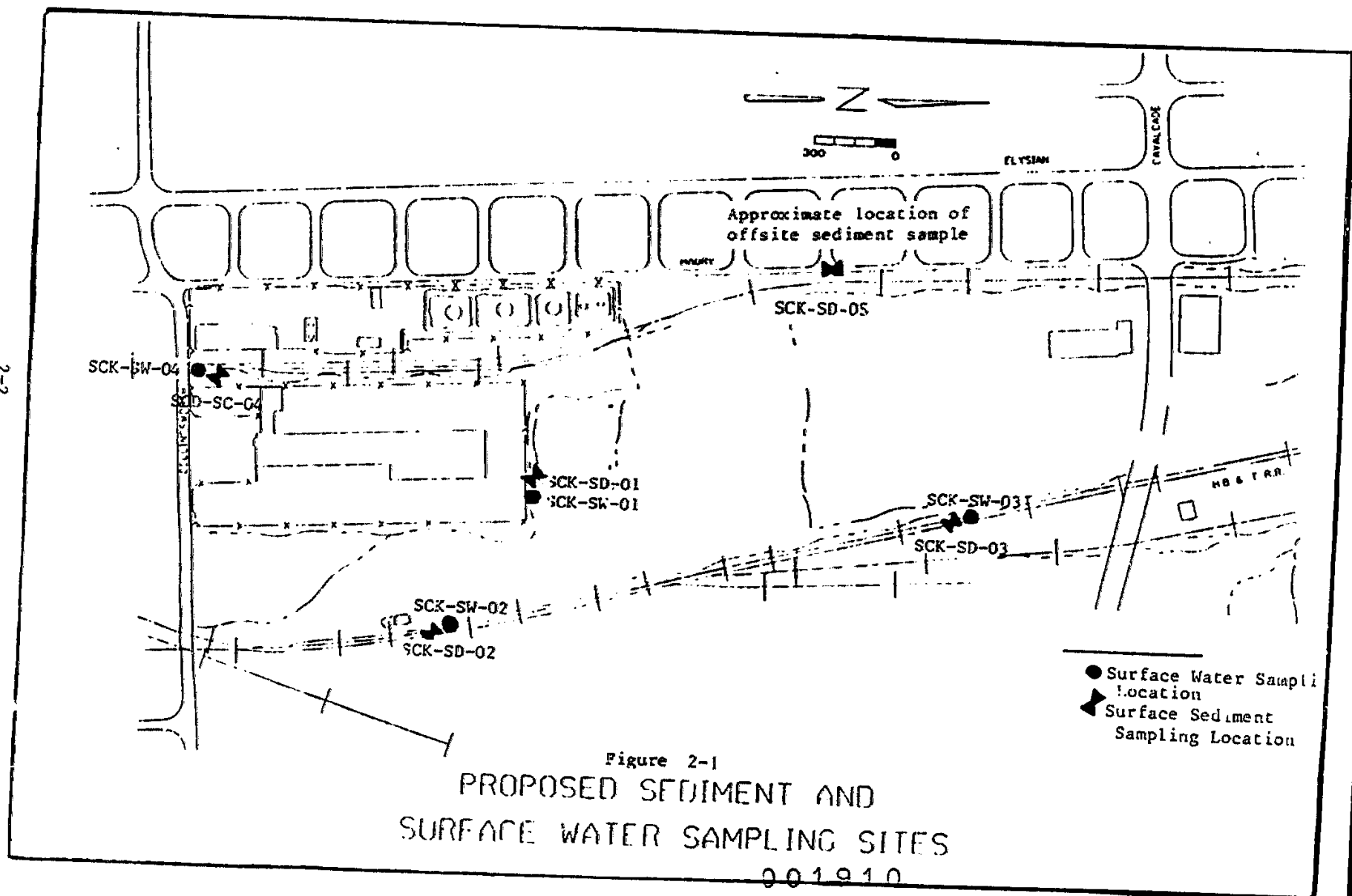
Tentative surface water sampling locations are shown in Figure 2-1 and consist of the following:

- o SCK-SW-01: The drainage ditch and catchment basins north and east of Meridian Fast Motor Freight Lines; one location
- o SCK-SW-02; SCK-SW-03: The drainage ditch on the east side of the site adjacent to the Houston Belt and Terminal railroad lines; two locations
- o SCK-SW-04: The drainage ditch adjacent to the Missouri Pacific Railroad lines at the southwest corner of the site where the ditch passes beneath Collingsworth Street; one location.

Additional sampling locations may be chosen after the site survey has been performed.

001909

2-2



2.3 Sampling Methodology

A pond or dip sampler shall be used for sampling surface waters. The sampler consists of a container attached to the end of a telescopic pole by a clamp. Samples will be collected in a jar or beaker made of stainless steel, glass or non-reactive plastic. Preferably a disposable beaker will be used which can be disposed of after each sampling station. The water sample will then be poured into the prelabeled sample containers. If it is necessary to wade into the water to take samples, the sampling technician shall be careful not to disturb bottom sediments, and to wait until sediment settles before taking the sample. The sample will be taken mid-depth in mid-channel if flow is significant.

The specified field blank will consist of two sets of laboratory cleaned sample containers. One set of containers is empty and will serve as the sample containers that will be analyzed. The second set of containers are filled at the laboratory with laboratory demonstrated analyte free water. At the field location, this analyte free water is then passed through laboratory cleaned sample equipment and placed in the empty set of sample containers for analysis.

The standard operating procedure outlining surface-water sampling techniques (SOP 7120) is included in Appendix I. Field sampling equipment will be decontaminated between samples in accordance with SOP 7600 (Appendix II). All decontamination wash waters will be collected, containerized, and stored in accordance with RCRA regulations (no permit required) per 40 CFR Part 265, Subpart I (Appendix III). The Health and Safety Plan for this investigation details health and safety procedures for surface water sampling.

2.4 Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Container</u>	<u>Volume</u>	<u>Preservative</u>
Volatile Organics	2 VOA vials, Teflon-lined caps	2x40 ml.	Cool 40C, protect from light

<u>Specified Analysis</u>	<u>Container</u>	<u>Volume</u>	<u>Preservative</u>
Acid/Base/Neutral Fraction Mix	1 glass bottle, Teflon lined cap	1 L.	Cool 4°C, protect from light
Priority Pollutant Metals and Iron	Cubitainer	1 L.	HNO ₃ to pH 2 or less
Total Cyanide	Cubitainer	1 L.	Cool 4°C, NaOH to pH 12 or greater
Total Petroleum Hydrocarbons	Glass Jar	1 L.	Cool 4°C

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control Plan for this investigation. Chain of custody procedures for surface water samples are addressed in Section 4.5 of the Quality Assurance/Quality Control Plan for this investigation.

2.5 Sample Identification/Numbering

A comprehensive listing of sample numbers for the surface water samples is shown on Table 2-1, and may be summarized by the following:

Total samples:	surface water samples	16
	duplicates	2
	field blanks	<u>2</u>
		20

One field blank will be collected and analyzed for each day of surface water sampling.

For each sample taken during the course of the field investigation, a coding system will be used to identify various information concerning each sample. The sample numbers listed in Table 2-1, and analogous tables in Sections 3 through 7, consist of the following components:

- (1) Project identification - a three letter designation used to identify the site where the sample is being taken. For example, SCK will be used to designate the Koppers South Calvalcade site.

TABLE 2-1

SAMPLE IDENTIFICATION NUMBERS FOR SURFACE
WATER SAMPLES COLLECTED AT THE SOUTH CAVALCADE STREET SITE

<u>Sample Location</u> <u>Code Number</u> ^(a)	<u>Sample Number</u>
SCK-SW-01	SCK-SW01-001
	SCK-SW01-002
	SCK-SW01-003
	SCK-SW01-004
SCK-SW-02	SCK-SW02-001
	SCK-SW02-002
	SCK-SW02-003
	SCK-SW02-004
SCK-SW-03	SCK-SW03-001
	SCK-SW03-002
	SCK-SW03-003
	SCK-SW03-004
SCK-SW-04	SCK-SW04-001
	SCK-SW04-002
	SCK-SW04-003
	SCK-SW04-004
Duplicate ^(b)	SCK-SW05-001
	SCK-SW06-001
Field Blank ^(c)	SCK-SW07-001
	SCK-SW08-001

- (a) See Figure 2-1 for locations of surface water sampling points.
 (b) The location of two duplicate samples are to be selected in the field. Duplicates will be selected for two different sample locations.
 (c) Field blanks are to be collected from two locations selected in the field.

- (2) Sample type and location - a two or three letter designation following the project identification code. The sample types and corresponding codes for this investigation consist of the following:

SW - Surface water samples

SD - Surface Sediment samples

SLxxA - Subsurface soil samples collected during observation well installation, where "xx" is the observation well location number

SL - Subsurface soil samples

OW - Ground water observation well samples

AR - Air samples

A two digit designation indicating the sample location will be used following the sample type code

- (3) Sample number - a three digit code will be used to consecutively number samples taken for each sample type.

For example, SCK - OW01-002 designates the South Calvalcade site, shallow groundwater sample taken from observation well number 1, the second sample from that well.

During each sampling investigation one duplicate sample is to be collected for every 10 samples collected for use in evaluating the analytical precision of the characterization methods. The duplicate samples collected during the sampling investigation are to be selected randomly from different sample locations. Because the duplicate samples are to be selected at random, the two digit sample location code has been assigned an arbitrary code number. This number, while not identified on sample location maps in this plan, will correspond to one of the already designated sample locations. Field sample logs and field notebooks will identify this sample as being a duplicate and will document its corresponding location. This will eliminate any potential laboratory bias resulting from the sample labelling scheme.

001914

In addition to the duplicate samples collected, field blanks (one per media per day) are also to be prepared during the investigation for each sample set (i.e., surface water samples, surface sediment samples, etc.) The field blanks should be prepared at different locations selected at random. As with the duplicate samples, the two digit sample location code used in the sample identification number has been assigned an arbitrary code number. This number, while not identified on the sampling location maps in this plan, will correspond to one of the already designated sample locations. Field sample logs and field notebooks will identify this sample as being a field blank and will document its corresponding location. This will eliminate any potential laboratory bias resulting from the sample labelling scheme.

2.6 Field Analyses

The following field analyses shall be performed and noted on the water quality field data sheet or similar form shown on the last page of the surface water sampling standard operating procedure:

<u>Analyses</u>	<u>Method No.</u>
pH	150.1
Temperature	170.1
Conductivity	120.1
Dissolved Oxygen	360.1/360.2
Flow	(a)

2.7 Laboratory Analyses

For each sampling round, the following laboratory analyses shall be performed:

<u>Laboratory Analysis^a</u>	<u>Method No.</u>
1) Volatile Organics; Library search ^b	624
2) Acid Fraction; Library search ^c	625
3) Base/Neutral Fraction; Library search ^c	625
4) Priority Pollutant Metals	200.2
5) Cyanide	335
6) Iron	236
7) Total Petroleum Hydrocarbons*	418.1

(a) See Appendix IV for description of method.

For the second round of surface water samples, the field analyses will be conducted as previously noted with the following modifications for laboratory water sample analyses:

- 1) Volatile Organics; Library search^b -- Select one-third of samples
- 2) Iron -- Consult with EPA for approval to drop this analysis

*Analyses of the samples containing the surface film will be for Total Petroleum Hydrocarbons only. Fluorescence spectrophotometry will be used for this analysis.

Notes

- ^a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active Quality Assurance Program Plan.
- ^b The library search is to identify up to 10 compounds with concentrations greater than 10 percent of internal standards.
- ^c The library search is to identify up to 20 compounds from the acid and base/neutral fractions with concentrations in excess of 10 percent of internal standards.

Deliverables --

- 1) Results from field analyses
- 2) Results of the laboratory analyses
- 3) Completed chain-of-custody forms
- 4) Memorandum describing field activities including documentation of sample collection and handling techniques.

Contingency -- If the first round does not indicate contamination of the surface runoff from the site, the number and locations of the second round samples and the analyses performed will be the same as the first round. If contamination of the surface water is detected in either round, Koppers and the EPA will determine whether additional sampling will be required.

001916

2.8 Proposed Sampling Team

The following personnel are designated for the surface water sampling activity:

Field Coordinator - to be designated

Field Health and Safety Officer - to be designated

Field Technicians - to be designated

001917

3.0 SURFACE SEDIMENT CHARACTERIZATION

Surface sediment samples will be collected and analyzed from drainage ditches and catchment basins on or adjacent to the South Cavalcade Street site.

3.1 Sampling Frequency

Samples will be collected twice (two rounds) during the field sampling program. Samples will be taken during each surface water sampling round when "first flush" samples are taken (see Section 2.1).

3.2 Sampling Locations

Tentative surface sediment sampling locations are described below and indicated in Figure 3-1.

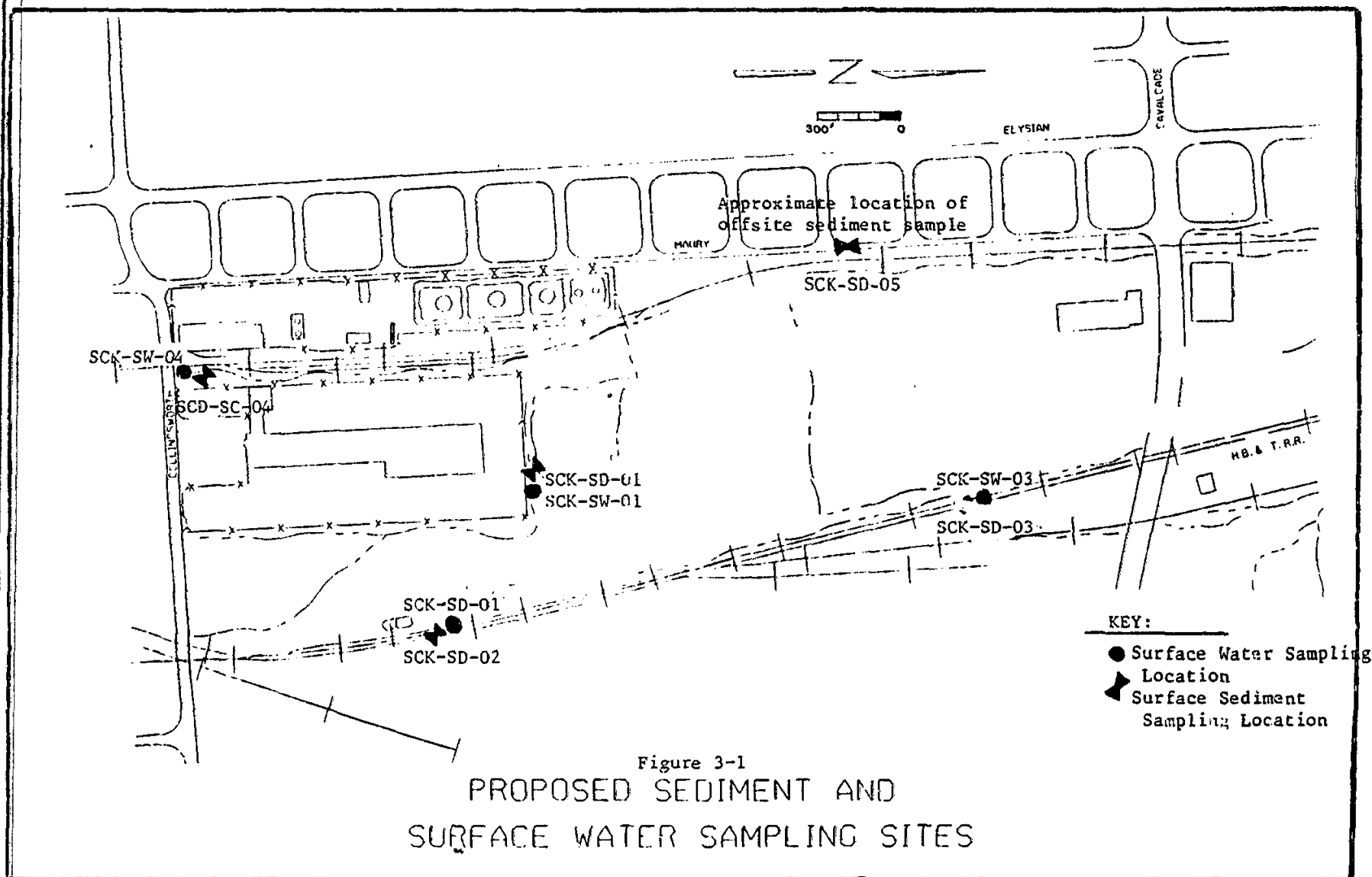
- 1) In the drainage ditch and catchment basins north and east of Meridian Fast Motor Freight Lines; one sample location. (SCK-SD-01).
- 2) In the drainage ditch on the east side of the site adjacent to the Houston Belt Terminal railroad lines: two sampling localities. (SCK-SD-02; SCK-SD-03).
- 3) In the drainage ditch adjacent to the Missouri Pacific Railroad lines at the southwest corner of the site. (SCK-SD-04).

(Additional samples may be collected from other low-lying areas or drainage courses where no runoff is encountered during sampling of surface water.)

3.3 Sampling Methodology

The standard operating procedure SOP 7140 included in Appendix V, outlines methods for lake and stream bottom sediment sampling. For sediment sampling at the South Cavalcade Street site, a shovel

001918



001919

or trowel (depending upon the depth of the ditch during sampling), rather than a dredge will be used. Note the accompanying sediment sample log sheet which will be completed for each sample taken. Also, for the purposes of establishing background surface sediment characterization, an off-site surface sediment sample (as shown in Figure 3-1) will be collected per sampling round.

The Health and Safety Plan for this investigation details health and safety procedures for surface sediment sampling.

3.4 Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Container</u>	<u>Volume</u>	<u>Preservative</u>
Volatile Organics	Two VOA vials, Teflon-lined caps	2 x 40 ml.	Cool 4°C, protect from light
Priority Pollutant Metals and Iron, Cyanide, Arsenic	1 wide mouth glass jar	8 oz.	None
Acid/Base/Neutral Fraction Mix	1 wide-mouth glass bottle Teflon-lined cap	8 oz.	Cool 4°C, protect from light
Particle Size Analysis	Wide-mouth jar	32 oz.	None

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control Plan for this investigation. Chain of custody procedures for sediment samples are addressed in Section 4.5 of the Quality Assurance/Quality Control Plan for this investigation.

3.5 Sample Identification/Numbering

A comprehensive listing of sample identification numbers that will be used for the proposed surface sediment samples is shown on Table 3-1, and is summarized as follows:

Total Samples:	Sediment Samples	8
	Duplicates	2
	Field blanks	<u>2</u>
		12

Refer to Section 2.5 for a detailed description of the sample identification and numbering system.

3.6 Laboratory Analyses

The surface sediment samples will be evaluated for the following laboratory analyses:

<u>Laboratory Analysis^a</u>	<u>Method No.</u>
1) Volatile Organics; Library search ^b	8240
2) Acid Fraction; Library search ^c	8250
3) Base/Neutral Fraction; Library search ^c	8250
4) Priority Pollutant Metals ^(d) plus Iron	6010
5) Cyanide	9010
6) Arsenic	7060/7061
7) Size Analysis	ASTM D-0422

Complete analyses, as described above, will be performed on the first round of sediment samples. For the second round of sediment samples, the following modifications will be implemented:

- o Volatile Organics; Library search^b -- Select one-third of samples
- o Iron will be deleted from the second round upon EPA approval

001921

Notes

- a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active Quality Assurance Program Plan.
- b The library search is to identify up to 10 compounds with concentrations greater than 10 percent of internal standards.
- c The library search is to identify up to 20 compounds from the acid and base/neutral fractions with concentrations greater than 10 percent of internal standards.
- d EPA Method 6010 cannot be used for mercury analysis. Method No. 7471 (Manual Cold-Vapor Technique) will be used.

Deliverables --

- 1) Results of the laboratory analyses
- 2) Completed chain-of-custody forms
- 3) Memorandum describing field activities including documentation of sample collection and handling techniques

Contingency -- Should extensive or severe levels of contamination be found in the surface sediments on or adjacent to the site, or should the results from the two rounds of surface sediment sampling be in conflict, additional sampling shall be required to resolve the contradiction and, if necessary, to ascertain the sources of the contamination. In addition, should sampling and analyses of the shallow groundwater beneath and adjacent to the site reveal the movement of contaminants to nearby drainage ditches and bayous, then the sampling of surface sediments in those drainage ditches and bayous shall be required. Furthermore, if the analytical results indicate the presence of pentachlorophenol at concentrations greater than 1000 ppm, further field investigations should cease immediately, and the scope of work reevaluated and revised.

3.7 Proposed Sampling Team

The following personnel are designated for the surface sediment sampling activity:

Field Coordinator - to be designated
Field Health and Safety Officer - to be designated
Field Technician(s) - to be designated

TABLE 3-1
SAMPLE IDENTIFICATION
NUMBERS FOR SURFACE SEDIMENT SAMPLES COLLECTED AT
THE SOUTH CAVALCADE STREET SITE

<u>Sample Location</u> <u>Code Number</u> ^(a)	<u>Sample Number</u>
SCK-SD-01	SCK-SD01-001 SCK-SD01-002
SCK-SD-02	SCK-SD02-001 SCK-SD02-002
SCK-SD-03	SCK-SD03-001 SCK-SD03-002
SCK-SD-04	SCK-SD04-001 SCK-SD04-002
SCK-SD-05	SCK-SD05-001 SCK-SD05-002
Duplicate ^(b)	SCK-SD06-001 SCK-SD07-001
Field Blank ^(c)	SCK-SD08-000 SCK-SD09-001

- (a) See Figure 3-1 for location of surface sediment samples.
 (b) The location of the two duplicate samples will be selected in the field. Duplicates will be selected for two different sample locations.
 (c) Field blanks will be collected during each sampling round (total of two field blanks) one per round.

001923

4.0 SUBSURFACE SOIL CHARACTERIZATION

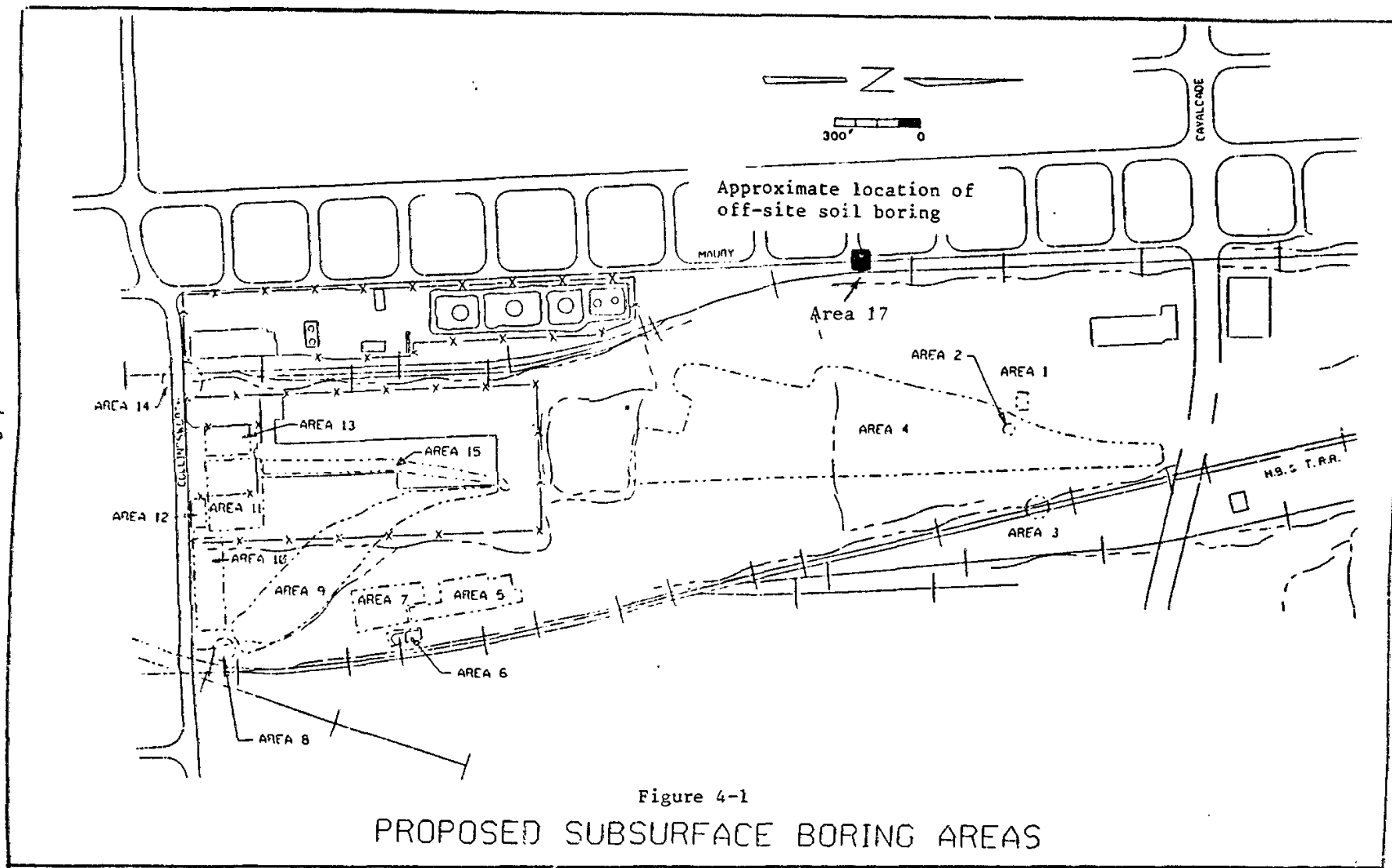
Subsurface soil samples are to be taken to characterize the degree of contamination of subsurface soils on the South Cavalcade Street site and the physical properties of the soil materials.

4.1 Sampling Locations

The following locations (area shown in Figure 4-1) have been tentatively defined for subsurface soil sampling. They may be modified based upon geophysical survey results, previous geotechnical and soil analytical data, and/or where the presence of permanent structures impede boring:

- 1) Area 1 -- In the vicinity of a lagoon identified in the northern part of the site. One borehole shall be advanced in the center of the suspected lagoon, a minimum of four boreholes shall be advanced around the indicated margins of the lagoon to better define its dimension and to ascertain the lateral and vertical extent of contamination.
- 2) Area 2 -- In the vicinity of a circular areas to the southeast of the suspected lagoon, where some non-soil material is visible and little plant life occurs. One borehole shall be advanced in the center of the circular area a minimum of three boreholes shall be advanced outside of the circular area to better define the lateral and vertical extent of any contamination associated with this area.
- 3) Area 3 -- In the vicinity of CAV-OW-14, a shallow observation well on the east side of the tract in which overt contamination was noted during installation. A minimum of three borings shall be advanced in this area to ascertain the nature and the extent of the contamination. Some borings may need to be advanced outside of the site boundary along the H. B. & T. Railroad tracks.

001924



001925

- 4) Area 4 -- In an area where treated lumber was commonly stored. A minimum of six borings shall be advanced in this area to ascertain the nature and extent of contamination.
- 5) Area 5 -- Beneath and around an old concrete loading dock that handled products from the tar refining plant. A minimum of five boreholes shall be advanced to ascertain whether spillage or leakage associated with the loading dock has contaminated the soils in the area.
- 6) Area 6 -- In the vicinity of two former spray ponds that were associated with the tar refining plant. Old plant drawings suggest that the ponds were constructed with concrete and measured 40' x 50' x 4.5' and 36.7' x 53.5' x 4.5'. Examination of 1944 aerial photography, however, suggests that the pond to the south was of earthen construction, at least at that time. A minimum of six boreholes shall be advanced to ascertain whether leakage associated with the former ponds has contaminated the underlying soils and to define the extent of potential contamination. Two of the boreholes shall be advanced within the area that the ponds once occupied; the remaining boreholes should be outside the former pond area.
- 7) Area 7 -- In the vicinity of the tanks and the main portion of the tar refinery on the east side of the site. At least one boring shall be advanced where each of the tanks (5), once stood or where overt contamination might be detected immediately outside of the footprints of the tanks, five additional borings should be advanced within the immediately adjacent to the footprint of the former tar processing plant.
- 8) Area 8 -- In the vicinity of the southeast corner of the site. No analyses were performed on samples previously collected from this area, thus, further sampling is necessary. A minimum of two boreholes shall be advanced in this area, one of which may be offsite.

001926

- 9) Area 9 -- In an area in which treated lumber was apparently commonly stored. A minimum of six borings shall be advanced in the area of determine the nature and extent of contamination.
- 10) Area 10 -- In the vicinity of the four large storage tanks that once occupied this area. One borehole shall be advanced where each of the tanks once stood or where overt contamination might be detected immediately outside of the tank footprint. Up to eight additional borings shall be advanced to ascertain the lateral and vertical extent of contamination that might have emanated from the tanks.
- 11) Area 11 -- In the vicinity of the old retort and the storage tanks that were once located in the southern part of the site. A rectangular sampling area that encompasses the locations of these former facilities should be established. Four borings shall be advanced at the corners of the sampling area; two should be advanced within the rectangular area.
- 12) Area 12 -- In the vicinity of an old cooling pond identified on a 1951 drawing of the wood treating and preserving facility. A minimum of three boreholes shall be advanced on the east, west, and south sides of the former pond to discern signs of any contamination that might be related to the former cooling pond and to determine the lateral and vertical extent of contamination.
- 13) Area 13 -- Within and immediately adjacent to a former structure labeled on the 1951 plan of the facility as "Treated Lumber Shed, Earthern Floor." A minimum of four borings shall be advanced within an immediately adjacent to the footprint of this structure, but outside of any existing structures on the site, to discern signs of contamination, if any, and to determine its extent.

001927

- 14) Area 14 -- In the vicinity of the southwest corner of the site where overt contamination has been detected at the ground surface and in the groundwater in observation well CAV-OW-10. A minimum of four boreholes shall be excavated to determine the nature and extent of contamination detected in this area; two of these borings may be off-site.
- 15) Area 15 -- Along the drip tracks associated with the original creosoting plant and including the area in which treated lumber appears to have been stored. A minimum of four boreholes shall be advanced to ascertain the extent of contamination. If any, one of the borings should be outside of the indicated area of contamination.
- 16) In addition, a minimum of ten boreholes shall be advanced in the remaining areas of the site to ascertain whether additional areas of the site might be contaminated. In general, the boreholes should be advanced to allow relatively even coverage of the site. Specific localities should be selected, however, in response to:
- Information obtained from the review of Koppers Company files and interviews with current and former employees.
 - Further information obtained from the interpretation of historic aerial photographs.
 - Indications of soil contamination obtained during the geophysical investigation of the site.
 - Evidence of overt contamination found in performing surface water, sediment and the subsurface sampling; or
 - Any other indications of contamination at the site.
- 17) Area 17 -- Off-site soil boring. Tentatively located along western edge of property, between Maury Street and railroad line. May be moved based on results of geophysical survey.

001928

4.2 Sampling Methodology

Previously specified locations will first be investigated with a portable power auger in order to ascertain limit of soil contamination and to guide in the placement of subsurface borings. All samples from the power auger borings shall be visually described, and on the average, one sample from each boring shall be tested for the following:

- o zinc, chromium, copper, arsenic [with a portable x-ray fluorescence machine or equivalent]
- o total hydrocarbon with an HNu Photoionization Analyzer

Standard operating procedures for the HNu photoionization analyzer (SOP 7315) is presented in Appendix VI.

Following the preliminary subsurface soil investigation with the portable power auger, continuous borehole samples shall be obtained with a drill rig using a thin-walled tube or split spoon samples. In addition, off-site soil samples shall be taken and analyzed. (Refer to Figure 4-1 for the location of the off-site soil boring). The Standard Operating Procedure (SOP 7115) for subsurface soil sampling using a split spoon is included in Appendix VII. Field equipment will be decontaminated between borings in accordance with SOP 7600 (Appendix II). All decontamination wash waters will be collected, containerized, and stored in accordance with RCRA regulations (no permit required) per 40 CFR Part 265, Subpart I (Appendix III).

When samples are removed from the ground, they shall be checked for emissions of volatile organics using the HNu. After the sample is open, it shall again be checked for volatile organic emissions. The disturbed ends of the sample will be trimmed, then the sample will be described (soil boring log on the last page of subsurface soil sampling SOP 7115), sectioned and bottled for further analyses or storage. All non-analyzed samples shall be archived through the remedial design phase.

The boreholes are to be advanced to a minimum depth of five feet below the base of the shallow aquifer or until there is no overt contamination detected either visually, with the olfactory senses, or with field testing equipment. Approximately one half of the boreholes at any one sampling locality should be advanced to a minimum depth of 50 feet. All non-sample materials removed from the boreholes shall be collected, containerized, and stored in compliance with RCRA regulations (see attached Federal Regulations 40 CFR, Part 265, Subpart I; Appendix III) prior to proper disposal. No permit is needed for storage of the non-sample materials. The boreholes shall be grouted back to the surface with non-shrink bentonite-cement mix as the augers are withdrawn from the hole.

The Health and Safety Plan for this investigation details health and safety procedures for subsurface soil sampling.

4.3 Screening Analyses of Drill Rig Samples

All samples shall be screened visually, with the olfactory senses, and with an HNu instrument as previously described. In addition, after the sample has been placed in a bottle for storage or further testing, a head space analysis shall be performed with the HNu. Prior to analyzing the head space in each sample container, the soil samples are to be held for a period of 4 hours or longer at a temperature of approximately 20°C to provide a constant set of testing conditions. Selected samples shall be further screened by surrogate analysis for zinc, copper, lead, chromium, and arsenic using a portable X-ray fluorescence machine, or the equivalent. At a minimum, this shall include samples from each distinct soils material encountered in the borehole; approximately four samples per boring on the average. These selected samples shall also be analyzed in the laboratory for total petroleum hydrocarbons using a modified EPA method 3540/418.1 (fluorescence spectrophotometer), or equivalent.

001930

4.4 Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Containers</u>	<u>Volume</u>	<u>Preservative</u>
Iron, Chromium, Copper, Zinc, Arsenic, Lead	1 wide-mouth glass jar, Teflon-lined or plastic cap	8 oz.	None
Petroleum Hydrocarbons	1 wide-mouth glass jar	1 L	Cool 4°C, protect from light
Cyanide	1 wide-mouth glass jar, Teflon-lined cap	8 oz.	Cool 4°C
Acid/Base/Neutral Fraction Mix	1 wide-mouth glass jar, Teflon-lined cap	8 oz.	Cool 4°C, protect from light

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control plan for this investigation. Chain of custody procedures for soil samples are addressed in Section 4.5 of the Quality Assurance/Quality Control Plan for this investigation.

4.5 Sample Identification/Numbering

A comprehensive listing of sample numbers for the subsurface soil samples is shown on Table 4-1 and is summarized by the following:

Total Samples:	Soil Samples	360
	Duplicates ^(a)	36
	Field Blank ^(b)	(b)
	Total	<u>396</u>

(a) Thirty-six total duplicate samples will be collected. As only a limited number of the total samples will be laboratory analyzed, only a limited number of the duplicates (10% of the number of samples sent for laboratory analysis), will be laboratory analyzed.

(b) One field blank will be collected for each day of subsurface soil sampling. As the number of sampling days are unknown and only a limited number of the total samples will be laboratory analyzed, only a limited number of the total field blanks will be laboratory analyzed.

Refer to Section 2.5 of this plan for a detailed description of the sample identification and numbering system.

4.6 Laboratory Analyses

Of those samples selected for the surrogate analysis as mentioned in the Section 4.3 (Field Analyses), thirty samples or fifteen percent (whichever is greater) shall be analyzed for the following:^a

- 1) Acid and Base/Neutral Fraction Mix
(Capillary GC/MS; Method No. 8270);
Library Search^b
- 2) Metals; iron, zinc, copper, chromium, lead, (Method No. 6010)
arsenic (Method No. 7060/7061)
- 3) Cyanide, (Method No. 9010)

001932

Notes

- a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active Quality Assurance Program Plan.
- b The library search is to identify up to 20 compounds with concentrations greater than 10 percent of internal standards.

TABLE 4-1

SAMPLE IDENTIFICATION NUMBERS FOR SUBSURFACE SOIL
SAMPLES COLLECTED AT THE SOUTH CAVALCADE STREET SITE

<u>Area Number(a)</u>	<u>Sample Location Code Number(b)</u>	<u>Sample Identification Number</u>
1	SCK-SL-01	SCK-SL01-001
		SCK-SL01-002
		SCK-SL01-003
		SCK-SL01-004
	SCK-SL-02	SCK-SL02-001
		SCK-SL02-002
		SCK-SL02-003
		SCK-SL02-004
	SCK-SL-03	SCK-SL03-001
		SCK-SL03-002
		SCK-SL03-003
		SCK-SL03-004
	SCK-SL-04	SCK-SL04-001
		SCK-SL04-002
		SCK-SL04-003
		SCK-SL04-004
	SCK-SL-05	SCK-SL05-001
		SCK-SL05-002
		SCK-SL05-003
		SCK-SL05-004
	SCK-SL-06	SCK-SL06-001
		SCK-SL06-002
		SCK-SL06-003
		SCK-SL06-004

001933

TABLE 4-1 (Cont'd)

<u>Area Number</u> ^(a)	<u>Sample Location Code Number</u> ^(b)	<u>Sample Identification Number</u>
2	SCK-SL-07	SCK-SL07-001
		SCK-SL07-002
		SCK-SL07-003
		SCK-SL07-004
	SCK-SL-08	SCK-SL08-001
		SCK-SL08-002
		SCK-SL08-003
		SCK-SL08-004
	SCK-SL-09	SCK-SL09-001
		SCK-SL09-002
		SCK-SL09-003
		SCK-SL09-004
	SCK-SL-10	SCK-SL10-001
		SCK-SL10-002
		SCK-SL10-003
		SCK-SL10-004
	SCK-SL-11	SCK-SL11-001
		SCK-SL11-002
		SCK-SL11-003
		SCK-SL11-004
	SCK-SL-12	SCK-SL12-001
		SCK-SL12-002
		SCK-SL12-003
		SCK-SL12-004

001934

TABLE 4-1 (Cont'd)

<u>Area Number</u> (a)	<u>Sample Location Code Number</u> (b)	<u>Sample Identification Number</u>
4	SCK-SL-13	SCK-SL13-001
		SCK-SL13-002
		SCK-SL13-003
		SCK-SL13-004
	SCK-SL-14	SCK-SL14-001
		SCK-SL14-002
		SCK-SL14-003
		SCK-SL14-004
	SCK-SL-15	SCK-SL15-001
		SCK-SL15-002
		SCK-SL15-003
		SCK-SL15-004
	SCK-SL-16	SCK-SL16-001
		SCK-SL16-002
		SCK-SL16-003
		SCK-SL16-004
	SCK-SL-17	SCK-SL17-001
		SCK-SL17-002
		SCK-SL17-003
		SCK-SL17-004
	SCK-SL-18	SCK-SL18-001
		SCK-SL18-002
		SCK-SL18-003
		SCK-SL18-004
	SCK-SL-19	SCK-SL19-001
		SCK-SL19-002
		SCK-SL19-003
		SCK-SL19-004

001935

TABLE 4-1 (Cont'd)

<u>Area Number(a)</u>	<u>Sample Location Code Number(b)</u>	<u>Sample Identification Number</u>
5	SCK-SL-20	SCK-SL20-001
		SCK-SL20-002
		SCK-SL20-003
		SCK-SL20-004
	SCK-SL-21	SCK-SL21-001
		SCK-SL21-002
		SCK-SL21-003
		SCK-SL21-004
	SCK-SL-22	SCK-SL22-001
		SCK-SL22-002
		SCK-SL22-003
		SCK-SL22-004
	SCK-SL-23	SCK-SL23-001
		SCK-SL23-002
		SCK-SL23-003
		SCK-SL23-004
6	SCK-SL-24	SCK-SL24-001
		SCK-SL24-002
		SCK-SL24-003
		SCK-SL24-004
	SCK-SL-25	SCK-SL25-001
		SCK-SL25-002
		SCK-SL25-003
		SCK-SL25-004
	SCK-SL-26	SCK-SL26-001
		SCK-SL26-002
		SCK-SL26-003
		SCK-SL26-004

001936

TABLE 4-1 (Cont'd)

<u>Area Number</u> (a)	<u>Sample Location Code Number</u> (b)	<u>Sample Identification Number</u>
6	SCK-SL-27	SCK-SL27-001
		SCK-SL27-002
		SCK-SL27-003
		SCK-SL27-004
	SCK-SL-28	SCK-SL28-001
		SCK-SL28-002
		SCK-SL28-003
		SCK-SL28-004
	SCK-SL-29	SCK-SL29-001
		SCK-SL29-002
		SCK-SL29-003
		SCK-SL29-004
	SCK-SL-30	SCK-SL30-001
		SCK-SL30-002
		SCK-SL30-003
		SCK-SL30-004
	SCK-SL-31	SCK-SL31-001
		SCK-SL31-002
		SCK-SL31-003
		SCK-SL31-004
	SCK-SL-32	SCK-SL32-001
		SCK-SL32-002
		SCK-SL32-003
		SCK-SL32-004
	SCK-SL-33	SCK-SL33-001
		SCK-SL33-002
		SCK-SL33-003
		SCK-SL33-004

001937

TABLE 4-1 (Cont'd)

<u>Area Number</u> (a)	<u>Sample Location Code Number</u> (b)	<u>Sample Identification Number</u>
7	SCK-SL-34	SCK-SL34-001
		SCK-SL34-002
		SCK-SL34-003
		SCK-SL34-004
	SCK-SL-35	SCK-SL35-001
		SCK-SL35-002
		SCK-SL35-003
		SCK-SL35-004
	SCK-SL-36	SCK-SL36-001
		SCK-SL36-002
		SCK-SL36-003
		SCK-SL36-004
	SCK-SL-37	SCK-SL37-001
		SCK-SL37-002
		SCK-SL37-003
		SCK-SL37-004
	SCK-SL-38	SCK-SL38-001
		SCK-SL38-002
		SCK-SL38-003
		SCK-SL38-004
	SCK-SL-39	SCK-SL39-001
		SCK-SL39-002
		SCK-SL39-003
		SCK-SL39-004
8	SCK-SL-40	SCK-SL40-001
		SCK-SL40-002
		SCK-SL40-003
		SCK-SL40-004

001938

TABLE 4-1 (Cont'd)

<u>Area Number</u> ^(a)	<u>Sample Location Code Number</u> ^(b)	<u>Sample Identification Number</u>
8	SCK-SL-41	SCK-SL41-001
		SCK-SL41-002
		SCK-SL41-003
		SCK-SL41-004
9	SCK-SL-42	SCK-SL42-001
		SCK-SL42-002
		SCK-SL42-003
		SCK-SL42-004
	SCK-SL-43	SCK-SL43-001
		SCK-SL43-002
		SCK-SL43-003
		SCK-SL43-004
	SCK-SL-44	SCK-SL44-001
		SCK-SL44-002
		SCK-SL44-003
		SCK-SL44-004
	SCK-SL-45	SCK-SL45-001
		SCK-SL45-002
		SCK-SL45-003
		SCK-SL45-004
	SCK-SL-46	SCK-SL46-001
		SCK-SL46-002
		SCK-SL46-003
		SCK-SL46-004
	SCK-SL-47	SCK-SL47-001
		SCK-SL47-002
		SCK-SL47-003
		SCK-SL47-004

001939

TABLE 4-1 (Cont'd)

<u>Area Number(a)</u>	<u>Sample Location Code Number(b)</u>	<u>Sample Identification Number</u>
10	SCK-SL-48	SCK-SL48-001
		SCK-SL48-002
		SCK-SL48-003
		SCK-SL48-004
	SCK-SL-49	SCK-SL49-001
		SCK-SL49-002
		SCK-SL49-003
		SCK-SL49-004
	SCK-SL-50	SCK-SL50-001
		SCK-SL50-002
		SCK-SL50-003
		SCK-SL50-004
	SCK-SL-51	SCK-SL51-001
		SCK-SL51-002
		SCK-SL51-003
		SCK-SL51-004
	SCK-SL-52	SCK-SL52-001
		SCK-SL52-002
		SCK-SL52-003
		SCK-SL52-004
	SCK-SL-53	SCK-SL53-001
		SCK-SL53-002
		SCK-SL53-003
		SCK-SL53-004
	SCK-SL-54	SCK-SL54-001
		SCK-SL54-002
		SCK-SL54-003
		SCK-SL54-004

001940

TABLE 4-1 (Cont'd)

<u>Area Number</u> (a)	<u>Sample Location Code Number</u> (b)	<u>Sample Identification Number</u>
10	SCK-SL-55	SCK-SL55-001
		SCK-SL55-002
		SCK-SL55-003
		SCK-SL55-004
	SCK-SL-56	SCK-SL56-001
		SCK-SL56-002
		SCK-SL56-003
		SCK-SL56-004
	SCK-SL-57	SCK-SL57-001
		SCK-SL57-002
		SCK-SL57-003
		SCK-SL57-004
	SCK-SL-58	SCK-SL58-001
		SCK-SL58-002
		SCK-SL58-003
		SCK-SL58-004
	SCK-SL-59	SCK-SL59-001
		SCK-SL59-002
		SCK-SL59-003
		SCK-SL59-004
11	SCK-SL-60	SCK-SL60-001
		SCK-SL60-002
		SCK-SL60-003
		SCK-SL60-004
	SCK-SL-61	SCK-SL61-001
		SCK-SL61-002
		SCK-SL61-003
		SCK-SL61-004

001941

TABLE 4-1 (Cont'd)

<u>Area Number</u> (a)	<u>Sample Location Code Number</u> (b)	<u>Sample Identification Number</u>
11	SCK-SL-62	SCK-SL62-001
		SCK-SL62-002
		SCK-SL62-003
		SCK-SL62-004
	SCK-SL-63	SCK-SL63-001
		SCK-SL63-002
		SCK-SL63-003
		SCK-SL63-004
	SCK-SL-64	SCK-SL64-001
		SCK-SL64-002
		SCK-SL64-003
		SCK-SL64-004
	SCK-SL-65	SCK-SL65-001
		SCK-SL65-002
		SCK-SL65-003
		SCK-SL65-004
12	SCK-SL-66	SCK-SL66-001
		SCK-SL66-002
		SCK-SL66-003
		SCK-SL66-004
	SCK-SL-67	SCK-SL67-001
		SCK-SL67-002
		SCK-SL67-003
		SCK-SL67-004
	SCK-SL-68	SCK-SL68-001
		SCK-SL68-002
		SCK-SL68-003
		SCK-SL68-004

001942

TABLE 4-1 (Cont'd)

<u>Area Number(a)</u>	<u>Sample Location Code Number(b)</u>	<u>Sample Identification Number</u>
13	SCK-SL-69	SCK-SL69-001
		SCK-SL69-002
		SCK-SL69-003
		SCK-SL69-004
	SCK-SL-70	SCK-SL70-001
		SCK-SL70-002
		SCK-SL70-003
		SCK-SL70-004
	SCK-SL-71	SCK-SL71-001
		SCK-SL71-002
		SCK-SL71-003
		SCK-SL71-004
	SCK-SL-72	SCK-SL72-001
		SCK-SL72-002
		SCK-SL72-003
		SCK-SL72-004
14	SCK-SL-73	SCK-SL73-001
		SCK-SL73-002
		SCK-SL73-003
		SCK-SL73-004
	SCK-SL-74	SCK-SL74-001
		SCK-SL74-002
		SCK-SL74-003
		SCK-SL74-004
	SCK-SL-75	SCK-SL75-001
		SCK-SL75-002
		SCK-SL75-003
		SCK-SL75-004

001943

TABLE 4-1 (Cont'd)

<u>Area Number</u> ^(a)	<u>Sample Location Code Number</u> ^(b)	<u>Sample Identification Number</u>
14	SCK-SL-76	SCK-SL76-001
		SCK-SL76-002
		SCK-SL76-003
		SCK-SL76-004
15	SCK-SL-77	SCK-SL77-001
		SCK-SL77-002
		SCK-SL77-003
		SCK-SL77-004
	SCK-SL-78	SCK-SL78-001
		SCK-SL78-002
		SCK-SL78-003
		SCK-SL78-004
	SCK-SL-79	SCK-SL79-001
		SCK-SL79-002
		SCK-SL79-003
		SCK-SL79-004
	SCK-SL-80	SCK-SL80-001
		SCK-SL80-002
		SCK-SL80-003
		SCK-SL80-004
16	SCK-SL-81	SCK-SL81-001
		SCK-SL81-002
		SCK-SL81-003
		SCK-SL81-004
	SCK-SL-82	SCK-SL82-001
		SCK-SL82-002
		SCK-SL82-003
		SCK-SL82-004

001944

TABLE 4-1 (Cont'd)

<u>Area Number</u> (a)	<u>Sample Location Code Number</u> (b)	<u>Sample Identification Number</u>
16	SCK-SL-83	SCK-SL83-001
		SCK-SL83-002
		SCK-SL83-003
		SCK-SL83-004
	SCK-SL-84	SCK-SL84-001
		SCK-SL84-002
		SCK-SL84-003
		SCK-SL84-004
	SCK-SL-85	SCK-SL85-001
		SCK-SL85-002
		SCK-SL85-003
		SCK-SL85-004
	SCK-SL-86	SCK-SL86-001
		SCK-SL86-002
		SCK-SL86-003
		SCK-SL86-004
	SCK-SL-87	SCK-SL87-001
		SCK-SL87-002
		SCK-SL87-003
		SCK-SL87-004
	SCK-SL-88	SCK-SL88-001
		SCK-SL88-002
		SCK-SL88-003
		SCK-SL88-004
	SCK-SL-89	SCK-SL89-001
		SCK-SL89-002
		SCK-SL89-003
		SCK-SL89-004

001945

TABLE 4-1 (Cont'd)

<u>Area Number</u> ^(a)	<u>Sample Location Code Number</u> ^(b)	<u>Sample Identification Number</u>
16	SCK-SL-90	SCK-SL90-001
		SCK-SL90-002
		SCK-SL90-003
		SCK-SL90-004
	Duplicate ^(c)	SCK-SL91-001 through SCK-SL106-001
	Field Blank ^(d)	SCK-SLxxx-0000 through SCK-SLxxx-001 ^(e)

001946

-
- (a) See Figure 4-1 for locations of subsurface soil sample area numbers.
- (b) The sample location code numbers will be assigned to a specific field location when exact locations, within each area number, are selected.
- (c) The locations of the thirty-six duplicate samples are to be selected in the field. Duplicates will be selected for thirty-six different sample locations.
- (d) Field blanks are to be collected for each day of subsurface soil sampling, from different locations selected in the field.
- (e) As the exact number of sampling days are unknown, the 'xxx' will be filled in with consecutive numbers following 107.

These samples shall be fully representative of the contaminated and uncontaminated soils encountered on the site. Finally, should highly contaminated soils be encountered in Area 1 or elsewhere on the site, up to 3 samples per area shall be subjected to laboratory analyses of the following parameters:

<u>Laboratory Analysis^a</u>	<u>Method No.</u>
1) Volatile Organics; Library search ^b	8240
2) Acid Fraction; Library search ^c	8250
3) Bases/Neutral Fraction; Library search ^c	8250
4) Priority Pollutant Metals ^(d) plus Iron	6010
5) Cyanide	9010
6) Arsenic	7060/7061

Notes

- a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active Quality Assurance Program Plan.
- b The library search is to identify up to 10 compounds with concentrations greater than 10 percent of internal standards.
- c The library search to identify up to 20 compounds from the acids and bases/neutrals fractions with concentrations greater than 10 percent of internal standards.
- d EPA Method 6010 cannot be used for mercury analysis. Method No. 7471 (Manual Cold-Vapor Technique) will be used.

Data collected from previous geotechnical testing will be used whenever possible, with EPA approval. If additional testing is deemed necessary, a selected number of samples (up to 6, or approximately 1 per 10 acres) that have no apparent contamination may be tested to ascertain their physical parameters in sufficient detail for engineering design purposes. Uncontaminated soils for physical parameter analyses are defined as those soil samples which show no sign of visual contamination or detectable organic vapor as measured by HNu field testing. Geotechnical tests that may be performed to supplement past testing data include:

Geotechnical Analyses

- Natural moisture content (ASTM D-2216)
- Unit dry weight
- Atterberg limits (ASTM D-0423, ASTM D-0424, ASTM D-0427)
- Passing 200 mesh sieve
- Unconfined compressive strength (cohesive soils)
- Vertical permeability (clays or silty clays) (ASTM D-2434)(a)

(a) Method D-2434 is for sandy soils only. Currently, ASTM has no final, approved method for cohesive soils.

Deliverables --

- 1) Borehole Logs (Unified Soil Classification, at a minimum, but including blow counts, and static water levels in the boreholes)
- 2) Results of H_{Nu} head space readings
- 3) Results of surrogate analyses
- 4) Results of the laboratory analyses
- 5) Results of the geotechnical analyses
- 6) Copies of the field notes of the supervising geologists or engineer.

Contingency -- Should extensive or severe contamination of the subsurface soils on the site be indicated, but not adequately characterized by the above described subsurface investigation program, additional soil analyses, boreholes or trenches may be required. The required additional borings or trenches may be onsite or off-site. If the results of these analyses indicate the presence of pentachlorophenol at concentrations greater than 1000 ppm, further field investigations should cease immediately and the scope of work reevaluated and revised.

4.7 Proposed Sampling Team

The following personnel are designated for the subsurface soils sampling activity:

Field Coordinator - to be designated
Field Health and Safety Officer - to be designated
Drilling Subcontractor - to be designated

To ensure the drilling subcontractor is qualified to perform and accurately document the drilling activities, the subcontractor will be selected based on general subcontractor procurement criteria detailed in Section 4.2 of the Quality Assurance/Quality Control Plan for this investigation. Specifically, the experience of the drilling subcontractor will be evaluated based on:

- (1) Number, size and degree of difficulty of past projects
- (2) Project experience within the state of Texas
- (3) Review of experience and accreditations of proposed field personnel (supervising geologist).

001949

5.0 SHALLOW AQUIFER GROUNDWATER INVESTIGATION

Groundwater samples shall be collected in order to obtain information on the hydrology and water quality of shallow groundwater beneath and adjacent to the South Cavalcade Street site. An auxiliary purpose of collecting groundwater samples is to obtain additional information on the subsurface soils on the site.

5.1 Water Level Measurement and Sampling Frequency

Measurement of water levels (see Section 4.0 of SOP 7130; Appendix VIII) in the fourteen new observation wells and the eight existing observation wells shall be made no sooner than one week nor more than one month after installation of the new wells. Thereafter, water levels in all observation wells shall be measured at least quarterly for a period of one year and whenever samples are taken for water quality analyses. In addition, water levels shall be measured on a frequent basis (daily to weekly) following at least one period of wetter than normal weather to detect whether individual recharge events directly influence water levels in the shallow aquifer. To the extent possible, whenever water level measurements are made, all measurements shall be completed on the same day. Field equipment will be decontaminated between measurements in accordance with SOP 7600 (Appendix II).

The groundwater in all 14 newly installed on-site and off-site observation wells and 8 existing onsite observation wells shall be sampled for chemical analyses approximately four weeks after the new wells have been installed and again approximately three months later. Three to ten casing volumes shall be purged from each well, using a bailer, peristaltic pump, or other appropriate means, prior to removing the sample of record. Water produced during the purging operation shall be collected, containerized, and stored in accordance with RCRA (40 CFR Part 265, Subpart I; Appendix III) prior to proper disposal. No permit is needed for storage of the water. Should an observation well fail to yield the required quantity of water during purging, the well should be bailed or pumped dry and the sample obtained as soon as there is sufficient water in the well for

the required sample volume. If the analytical results are consistent, two rounds of sampling shall be deemed sufficient. If inconsistencies develop, a third sampling round may be required.

5.2 Sampling Locations

Eight pre-existing observation wells and fourteen new observation wells shall be sampled and monitored. Well locations for the twenty-two wells are shown in Figure 5-1. The existing wells are noted on the map with a "▲" and have location numbers beginning with "CAV-OW", whereas new well locations are noted with a "●" and begin with "SCK-OW". The location of the new wells shall be surveyed to the nearest 0.01 foot. The ground surface at the well and exposed casing stick up shall be surveyed to the nearest 0.1 foot, and a permanent mark affixed to the casing for subsequent consistent measurement of water levels. Locations for the fourteen new installations were selected based on available hydrologic and water quality data for the shallow aquifer. The wells are intended to better define the configuration of the water table in the shallow aquifer and to document the extent of groundwater contamination beneath the South Cavalcade Street Site and its migration from the site. Alternate localities may be selected based on:

- Information obtained from review of Koppers Company files and interviews with current and former employees.
- Further information obtained from the interpretation of historic aerial photographs.
- The geophysical investigation,
- Other indications of contamination at the site or conflicts with the localities selected.

5.3 Observation Well Installation

The observation wells should be constructed, completed and developed according to the procedures outlined in the general, standard operating procedure (SOP 7220; Appendix IX). Specific details of well construction for this site include 2 inch ID,

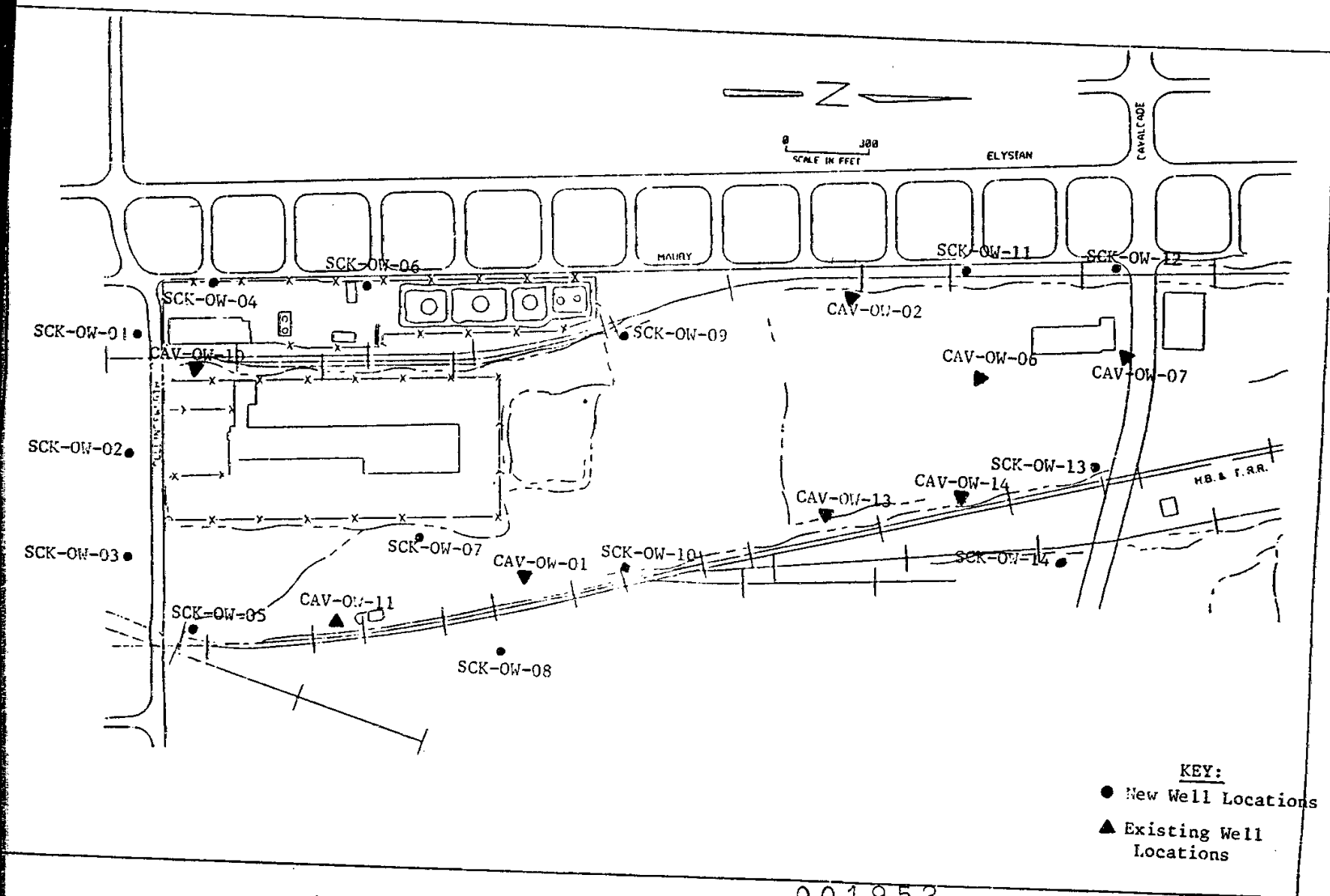


Figure 5-1 Existing and New Observation Well Locations for Shallow Aquifer Groundwater Sampling

flush-threaded, schedule 40 PVC pipe for the well casing. The well screen will be 2 inch ID, flush-threaded, manufactured PVC well screen. The well screen will be 10 feet in length and have 0.010 inch slots. The grouting above the sand filter pack will be a 2 foot bentonite seal followed by a cement/bentonite (10%) backfill to the surface. A locking protective steel casing will be cemented into the backfill to protect the well.

The observation wells will be developed to as sediment-free a condition as possible using air lifting, surging, pumping or other appropriate techniques. Development will proceed for a minimum of thirty minutes or 5 casing volumes, whichever takes longer. A sediment-free condition will be defined as less than 0.01 ml of sand collected in a 1000 ml Imhoff cone when sampled 1 to 2 minutes after start of pumping or a total maximum development time of 2 hours. All water produced during development of the wells will be collected, containerized and stored in compliance with RCRA regulations (40 CFR Part 265, Subpart I; Appendix III) prior to proper disposal. No permit is needed for storage of the water produced during well development. During the course of observation well installation, continuous soil samples shall be taken to a depth of two feet below the shallow aquifer. A minimum of four samples from each well location shall be collected and analyzed for the following:

- o Visual and olfactory screening
- o HNu analyses
- o Head space analysis
- o Portable x-ray fluorescence analysis or equivalent (Zn, Cu, Pb, Cr, As)
- o Total Petroleum Hydrocarbons (infrared spectrophotometry)

The Health and Safety Plan for this investigation details health and safety procedures for soil sampling and monitoring well installation.

Table 5-1 contains a comprehensive listing of soil sample numbers to be used for observation well installation soil samples.

Refer to Section 2.5 of this plan for a detailed description of the sample identification and numbering system.

All downhole equipment shall be steam-cleaned prior to commencing drilling at each hole; all sampling equipment shall be properly cleaned prior to reuse in accordance with SOP 7600 (Appendix II). All nonsample materials removed from the well shall be collected, containerized, and stored in compliance with RCRA regulations (Federal Regulations 40 CFR, Part 265, Subpart I; Appendix III) prior to proper disposal. No permit is needed for storage of the nonsample materials.

5.4 Sampling Methodology

The standard operating procedure (SOP 7130; Appendix VIII) for groundwater sample collection from monitoring wells, attached to the end of this section, is to be followed when collecting samples. The bailing method discussed in Section 7.1 of SOP 7130 is to be used for collecting unfiltered volatile organic samples. Field equipment will be decontaminated prior to and between samples in accordance with SOP 7600. In addition to the outlined procedure, all water produced during development of the wells shall be collected, containerized, and stored in accordance with RCRA regulations per 40 CFR Part 265, Subpart I prior to proper disposal. No permit is needed for storage of the water produced during pumping.

The specified field blank shall consist of two sets of laboratory cleaned sample containers. One set of containers is empty and will serve as the sample containers that will be analyzed. The second set of containers are filled at the laboratory with laboratory demonstrated analyte free water. At the field location, this analyte free water is then passed through laboratory cleaned sample equipment and placed in the empty set of sample containers for analysis.

The Health and Safety Plan for this investigation details health and safety procedures for groundwater sampling.

TABLE 5-1
SAMPLE IDENTIFICATION NUMBERS FOR SOIL SAMPLES
COLLECTED FROM SHALLOW AQUIFER OBSERVATION WELL INSTALLATION
COLLECTED AT THE SOUTH CAVALCADE STREET SITE

<u>Sample Location Code Number(a)</u>	<u>Sample Number</u>
SCK - OW - 01	SCK - SL01A - 001
	SCK - SL01A - 002
	SCK - SL01A - 003
	SCK - SL01A - 004
SCK - OW - 02	SCK - SL02A - 001
	SCK - SL02A - 002
	SCK - SL02A - 003
	SCK - SL02A - 004
SCK - OW - 03	SCK - SL03A - 001
	SCK - SL03A - 002
	SCK - SL03A - 003
	SCK - SL03A - 004
SCK - OW - 04	SCK - SL04A - 001
	SCK - SL04A - 002
	SCK - SL04A - 003
	SCK - SL04A - 004
SCK - OW - 05	SCK - SL05A - 001
	SCK - SL05A - 002
	SCK - SL05A - 003
	SCK - SL05A - 004
SCK - OW - 06	SCK - SL06A - 001
	SCK - SL06A - 002
	SCK - SL06A - 003
	SCK - SL06A - 004

001955

TABLE 5-1 (Continued)

<u>Sample Location</u> <u>Code Number(a)</u>	<u>Sample Number</u>
SCK - OW - 07	SCK - SL07A - 001
	SCK - SL07A - 002
	SCK - SL07A - 003
	SCK - SL07A - 004
SCK - OW - 08	SCK - SL08A - 001
	SCK - SL08A - 002
	SCK - SL08A - 003
	SCK - SL08A - 004
SCK - OW - 09	SCK - SL09A - 001
	SCK - SL09A - 002
	SCK - SL09A - 003
	SCK - SL09A - 004
SCK - OW - 10	SCK - SL10A - 001
	SCK - SL10A - 002
	SCK - SL10A - 003
	SCK - SL10A - 004
SCK - OW - 11	SCK - SL11A - 001
	SCK - SL11A - 002
	SCK - SL11A - 003
	SCK - SL11A - 004
SCK - OW - 12	SCK - SL12A - 001
	SCK - SL12A - 002
	SCK - SL12A - 003
	SCK - SL12A - 004
SCK - OW - 13	SCK - SL13A - 001
	SCK - SL13A - 002
	SCK - SL13A - 003
	SCK - SL13A - 004

001956

TABLE 5-1 (Continued)

<u>Sample Location Code Number</u> (a)	<u>Sample Number</u>
SCK - OW - 14	SCK - SL14A - 001
	SCK - SL14A - 002
	SCK - SL14A - 003
	SCK - SL14A - 004

(a) See Figure 5-1 for locations of observation wells.

001957

5.5 Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Container</u>	<u>Volume</u>	<u>Preservative</u>
Volatile Organic Compounds	2 VOA Vials, Teflon-lined caps	2 x 40ml	Cool 4°C, protect from light
Acid/Base/Neutral Fraction Mix, Pesticides, and PCB	1 Glass Bottle, Teflon-lined cap	1 L.	Cool 4°C, protect from light
Priority Metals and Iron	Cubitainer	1 L.	HNO ₃ to pH 2 or less
Cyanide	Cubitainer	1 L.	Cool 4°C, NaOH to pH 12 or greater
Nitrates	Cubitainer	1 L.	Cool 4°C

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control Plan for this investigation. Chain of custody procedures for groundwater samples are addressed in Section 4.5 of the Quality Assurance/Quality Control Plan for this investigation.

5.6 Sample Identification/Numbering

A comprehensive listing of sample numbers for shallow groundwater samples is shown on Table 5-2 and is summarized as follows:

Total Samples:	
Groundwater samples	44
Duplicates	5
Field Blanks	<u>2</u>
	51

One field blank will be collected and analyzed for each day of shallow groundwater sampling. Refer to Section 2.5 of this plan for a detailed description of the sample identification and numbering system.

5.7 Aquifer Properties Analysis

Aquifer properties in the shallow aquifer shall be determined using selected observation wells, which, based on one or more rounds of water quality analyses, appear to be relatively free of contamination. A falling-head permeability test shall be used and the standard operating procedure for this test (SOP 7220) is included in Appendix IX. Any water removed from the wells shall be collected, containerized, and stored in accordance with RCRA regulations (per 40 CFR 265, Subpart I) prior to proper disposal. Aquifer tests should be performed at approximately five wells.

The Health and Safety Plan for this investigation details the health and safety procedures for well permeability testing.

5.8 Field Analysis

The following groundwater analyses shall be performed in the field:

<u>Field Analyses</u>	<u>Method No.</u>
1) pH	150.1
2) Conductivity	120.1
3) Temperature	170.1

5.9 Laboratory Analyses

The following laboratory analytical procedures shall be required:

<u>Laboratory Analysis^a</u>	<u>Method No.</u>
1) Volatile Organics; Library search ^b	624
2) Acid Fraction; Library search ^c	625
3) Base/Neutral Fraction; Library search ^c	625
4) Priority Pollutant Metals	200.2
5) Cyanide	335
6) Iron	236
7) Nitrate	300
8) Pesticides & PCB's	608

Notes

- a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active Quality Assurance Program Plan.
- b The library search is to identify up to 10 compounds with concentrations greater than 10 percent of internal standards.
- c The library search is to identify up to 20 compounds from the acid/base/neutral fractions with concentrations greater than 10 percent of internal standards.

The analysis of the 22 shallow groundwater samples collected during the second round may be modified as follows:

- 1) Volatile Organics; Library search^d - select one-third of samples collected
 - 2) Acid Fraction; Library search^e
 - 3) Base/Neutral Fraction; Library search^e
 - 4) Priority Pollutant Metals - select one-third of samples collected
 - 5) Copper, chrome, zinc and arsenic remaining two-thirds of samples collected.
 - 6) Iron - consult with EPA
 - 7) Pesticides and PCB's - select one-third of samples collected
-
- d The library search to identify up to 10 compounds with concentrations greater than 10 percent of the internal standards can be limited to a select one-third of the samples
 - e The library search to identify up to 20 compounds from the acid/base/neutral fractions with concentrations greater than 10 percent of the internal standards can be limited to a select one-third of the samples.

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TABLE 5-2
SAMPLE IDENTIFICATION NUMBERS FOR
SHALLOW AQUIFER GROUNDWATER SAMPLES COLLECTED AT
THE SOUTH CAVALCADE STREET SITE

<u>Sample Location Code Number(a)</u>	<u>Sample Identification Number</u>
CAV - OW - 01	CAV - OW01 - 001
	CAV - OW01 - 002
CAV - OW - 02	CAV - OW02 - 001
	CAV - OW02 - 002
CAV - OW - 07	CAV - OW07 - 001
	CAV - OW07 - 002
CAV - OW - 08	CAV - OW08 - 001
	CAV - OW08 - 002
CAV - OW - 10	CAV - OW10 - 001
	CAV - OW10 - 002
CAV - OW - 11	CAV - OW11 - 001
	CAV - OW11 - 002
CAV - OW - 13	CAV - OW13 - 001
	CAV - OW13 - 002
CAV - OW - 14	CAV - OW14 - 001
	CAV - OW14 - 002
SCK - OW - 01	SCK - OW01 - 001
	SCK - OW01 - 002
SCK - OW - 02	SCK - OW02 - 001
	SCK - OW02 - 002

001961

TABLE 5-2 (Cont'd)

<u>Sample Location Code Number (a)</u>	<u>Sample Identification Number</u>
SCK - OW - 03	SCK - OW03 - 001 SCK - OW03 - 002
SCK - OW - 04	SCK - OW04 - 001 SCK - OW04 - 002
SCK - OW - 05	SCK - OW05 - 001 SCK - OW05 - 002
SCK - OW - 06	SCK - OW06 - 001 SCK - OW06 - 002
SCK - OW - 07	SCK - OW07 - 001 SCK - OW07 - 002
SCK - OW - 08	SCK - OW08 - 001 SCK - OW08 - 002
SCK - OW - 09	SCK - OW09 - 001 SCK - OW09 - 002
SCK - OW - 10	SCK - OW10 - 001 SCK - OW10 - 002
SCK - OW - 11	SCK - OW11 - 001 SCK - OW11 - 002
SCK - OW - 12	SCK - OW12 - 001 SCK - OW12 - 002
SCK - OW - 13	SCK - OW13 - 001 SCK - OW13 - 002

001962

TABLE 5-2 (Cont'd)

<u>Sample Location Code Number^(a)</u>	<u>Sample Identification Number</u>
SCK - OW - 14	SCK - OW14 - 001 SCK - OW14 - 002
Duplicate ^(b)	SCK - OW15 - 001 SCK - OW16 - 001 SCK - OW17 - 001 SCK - OW18 - 001 SCK - OW19 - 001
Field Blank ^(c)	SCK - OW20 - 001 SCK - OW21 - 001

001963

-
- (a) See Figure 5-1 for locations of observation wells.
- (b) The location of the five duplicate samples will be selected in the field. Duplicates will be selected for five different sample locations. Both existing and newly-installed wells should be used for duplicate sample locations.
- (c) Field blanks will be collected from two different locations selected in the field. Both existing and newly-installed wells should be used for field blank locations.

If further sampling is required after two rounds due to inconsistencies between the first two rounds, then EPA and Koppers shall determine selected parameters to be eliminated from the analysis.

Deliverables --

- 1) Well logs and completion records for all newly installed observation wells
- 2) Documentation of the volume and disposition of all water and residual soils materials removed from the wells
- 3) Copies of the field notebook of the supervising geologist or engineer
- 4) All water level measurements and interpretations of the configuration of the water table in the shallow aquifer
- 5) Field analysis results
- 6) Analytical laboratory results
- 7) Copies of the chain of custody forms
- 8) Raw data and results of all aquifer tests

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Contingency -- Should extensive or severe levels of contamination be found in the shallow aquifer beneath the site, leaving or having the potential to leave the confines of the site, or in areas adjacent to the site, installation of additional observation wells may be required to ascertain the extent, concentrations, and rate of migration of the contaminants. Monitoring beyond the one year specified above may also be required.

5.10 Proposed Sampling Team

The following personnel are designated for the shallow groundwater investigation activity:

- Field Coordinator - to be designated
- Field Health and Safety Officer - to be designated
- Field Technician(s) - to be designated

6.0 DEEPER GROUNDWATER INVESTIGATION

Groundwater samples shall be collected and analyzed from observation wells in order to obtain information on the water quality of the deeper aquifer (approximately 200 feet below the ground), and, if necessary, to investigate the hydrology of the deeper aquifer system.

6.1 Water Level Measurements and Sampling Frequency

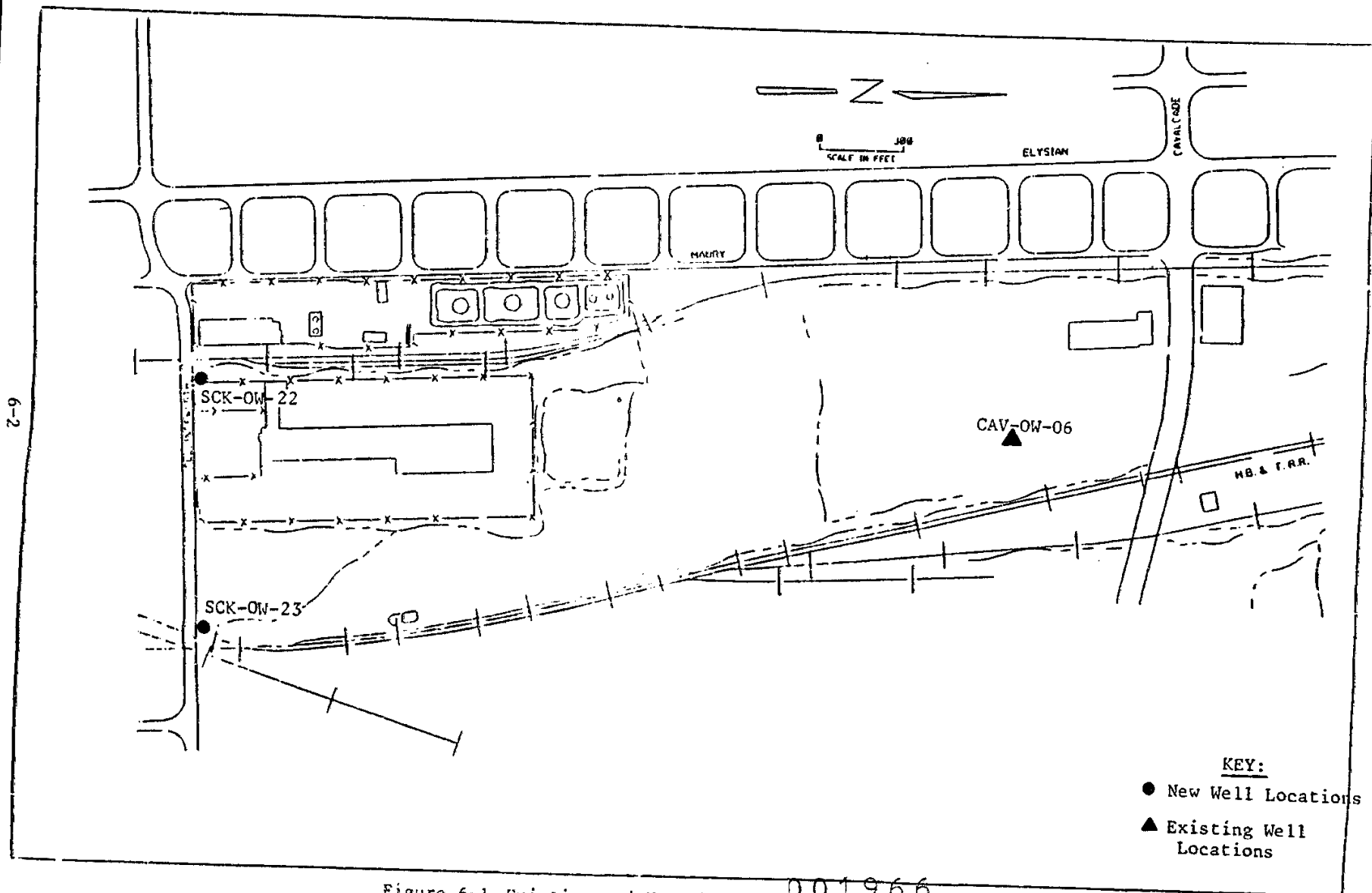
As for the shallow aquifer samples, measurement of water levels (see Section 4.0 of SOP 7130; Appendix VIII) in the deeper aquifer shall be made no sooner than one week nor more than one month after installation of the wells. Thereafter, water levels in the wells should be measured on a quarterly basis and at each time samples are obtained for analyses of water quality. All downhole measuring equipment shall be properly cleaned prior to use (see Section 4.5 of SOP 7130).

The groundwater in the deeper aquifer shall be sampled approximately one month after installation of the wells and again approximately three months later. Prior to sampling, a minimum of ten casing volumes of groundwater is to be removed from the well. The groundwater is to be collected, containerized and stored in accordance with RCRA regulations (40 CFR, Part 265, Subpart I) prior to proper disposal. No permit is needed for storage of the water.

6.2 Sampling Locations

Based on available information, installation of two deep wells into the deeper aquifer in the southeast and southwest corners of the site are considered adequate (Figure 6-1). These wells, in addition to the existing well in the northern portion of the site (CAV-OW-06), should be sufficient to confirm the quality of water in the deeper aquifer.

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001966
Figure 6-1 Existing and New Observation Well Locations for
Deeper Aquifer Groundwater Sampling
(South Cavalcade Street Site)

6.3 Observation Well Installation

Observation wells installed into the deeper aquifer are to be constructed and completed using the general standard operating procedure on monitoring well construction (SOP 7220; Appendix IX) found at the end of Section 6.0 as a guideline. Construction and completion techniques specific to this site include the use of a telescoping well installation procedure. The well bore will be advanced through the shallow aquifer using mud rotary techniques. Augers (10 to 8 inches in diameter) will be used to advance the well bore. A heavy mud (1.2 specific gravity) of pure high sodium bentonite will be added to the wellbore during the drilling. The mud level will be maintained as high above the groundwater table as possible. This procedure is used to advance the well bore into the confining formation below the shallow aquifer. A soil sample from the terminus of this well bore will be examined visually and with the HNu field instrument for indications of contamination. It will also be analyzed in the laboratory to confirm that it is free of contamination.

The well bore will then be sealed off with a 6 to 8 inch steel casing to the terminus of the initial boring. A tremie pipe will be inserted into the annular space between the well bore and the steel casing such that bentonite cement grout can be injected into the space, from the bottom of the boring to the top.

After a 24 hour time period, the inside surface of the casing will be cleaned and the well bore will be advanced to its target depth (approximately 200 feet) using the same mud rotary technique as described above.

The well casing will be 4 inch ID, flush-threaded, schedule 80 PVC pipe. The manufactured well screen will be 4 inch ID, flush-threaded, schedule 80 PVC pipe with 0.010 inch slots. All piping and well screen will be steam cleaned prior to installation. The entire interval of the deeper aquifer will be screened. A sand filter pack will extend 2 feet above the top of the screen and will be installed

001967

as the augers are removed. A 5 foot bentonite seal will be placed above the sand filter pack followed by a cement/bentonite (10%) backfill to the surface.

Twenty-four hours after completion, the well will be developed to as sediment-free a condition as possible using air lifting, surging or pumping techniques. A sediment-free condition will be defined as not more than 0.01 ml of sand collected in a 1000 ml Imhoff cone when sampling 1 to 2 minutes after pumping begins. Once free of apparent sediment, the well will be pumped for eight hours at 10 gallons per minute, or equivalent volume.

All drilling mud, cuttings and water produced by completion or purging will be collected, containerized and stored in compliance with RCRA regulations (40 CFR Part 265, Subpart I) prior to proper disposal. No permit is needed for storage of these materials.

The Health and Safety Plan for this investigation details health and safety procedures for well installation.

6.3.1 Soil Sampling Methodology

A sample from the terminus of the initial boring (confining layer below the shallow aquifer) is to be collected for laboratory analysis to confirm that it is free of contamination. In addition, soil samples are to be taken for field and/or laboratory analysis. Soil samples are to be collected at 5 foot intervals to a depth of 50 feet, and at 10-foot intervals thereafter, and at each change of soil strata.

The Health and Safety Plan for this investigation details health and safety procedures for subsurface soil sampling.

6.3.2 Screening Analysis of Soils

The following analyses are to be performed on selected samples collected as noted in Section 6.3.1.

- o Visual and olfactory screening
- o HNu analyses (see SOP 7315, Appendix VI)
- o Head space analysis
- o Portable x-ray fluorescence analysis or equivalent (Zn, Cu, Pb, Cr, As)
- o Total Petroleum Hydrocarbons (Fluorescence spectrophotometry)

Head space analyses are to be performed using an HNu instrument after the soil samples are held for a period of 4 hours or longer at a temperature of about 20°C.

6.3.3 Laboratory Analysis of Soils

Based on the test findings from the screening analyses, eight soil samples will be selected in the field and submitted for laboratory analysis for the following parameters.

<u>Laboratory Analyses^a</u>	<u>Method No.</u>
1) Acid and Base/Neutral Fraction Mix (Capillary GC/MS)	8270
2) Zinc, copper, chromium, lead	6010
3) Arsenic	7060/7061
4) Cyanide	9010

^a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active QA Program Plan.

6.3.4 Soil Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Containers</u>	<u>Volume</u>	<u>Preservative</u>
Metals (Zn, Cu, Cr, Pb, As)	Wide-mouth glass jar for all tests	8 oz.	None
Acid and Base Neutral Fraction Mix	One wide-mouth glass jar, Teflon-lined cap	8 oz.	Cool 4°C, protect from light

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control Plan for this investigation. Chain-of-custody procedures for soil samples are addressed in Section 4.5 of the Quality Assurance/Quality Control Plan for this investigation.

6.3.5 Soil Sample Identification/Numbering

Table 6-1 contains a comprehensive listing of soil sample numbers to be used for observation well installation soil samples.

Soil Samples	8
Duplicates	1
Field Blank ^(a)	$\frac{(a)}{9(a)}$

(a) One field blank will be collected for each day of subsurface soil sampling. As the number of sampling days are unknown and only a limited number of the total samples will be laboratory analyzed, only a limited number of the total field blanks will be laboratory analyzed.

Refer to Section 2.5 of this plan for a detailed description of the sample identification and numbering system.

All downhole equipment shall be steam-cleaned prior to commencing drilling at each hole; all sampling equipment shall be properly cleaned prior to reuse (see SOP 7600). All nonsample materials removed from the well shall be collected, containerized, and stored in compliance with RCRA regulations per 40 CFR, Part 265, Subpart I, prior to proper disposal. No permit is needed for storage of the soil.

6.4 Observation Well Monitoring

6.4.1 Sampling Methodology

The standard operating procedure for groundwater sample collection from monitoring wells is presented in SOP 7130; Appendix VIII. In addition to the outlined standard operating procedure, all water produced during development of the wells is to be collected, containerized, and stored in accordance with RCRA regulations (40 CFR, Part 265, Subpart I) prior to proper disposal. No permit is needed for storage of the water produced.

The field blank consist of two sets of laboratory cleaned sample containers. The first set of containers are to be filled at the laboratory with laboratory demonstrated analyte free water. The second set of containers is shipped empty. At the field location, analyte free water will be passed through laboratory cleaned sample equipment and placed in the empty set of sample containers for analysis.

The Health and Safety Plan for this investigation details health and safety procedures for groundwater sampling.

6.4.2 Field Analysis of Groundwater Samples

The following field analyses are to be performed on all deeper aquifer samples.

<u>Field Analyses</u>	<u>Method No.</u>
1) pH	150.1
2) Conductivity	120.1
3) Temperature	170.1

6.4.3 Laboratory Analysis of Groundwater Samples

The following laboratory analyses are to be performed on all deeper aquifer samples.

<u>Laboratory Analysis^a</u>	<u>Method No.</u>
1) Volatile Organics; Library search ^b	624
2) Acid Fraction; Library search ^c	625
3) Base/Neutral Fraction; Library search ^c	625
4) Priority Pollutant Metals	200.2
5) Iron	236
6) Nitrate	300
7) Pesticides and PCB's	608
8) Cyanide	335

Notes

- a All laboratory analyses are to be performed by a qualified and experienced laboratory maintaining an active QA Program Plan.
- b The library search is to identify up to 10 compounds with concentrations greater than 10 percent of internal standards.
- c The library search is to identify up to 20 compounds from the acid and base/neutral fractions with concentrations in excess of 10 percent of internal standards.

Complete analyses, as described above, shall be performed on the first round of deep groundwater samples. For the second round, the analyses for nitrate and iron may be dropped, with EPA approval. If further groundwater sampling is required after two rounds, selected parameters may be eliminated from the analyses with EPA approval.

Deliverables --

- 1) Well logs and completion records for the wells installed into the deeper aquifer
- 2) Documentation of the disposition of all water produced during installation, development and sampling of the deeper wells
- 3) Copies of the field notebook of the supervising geologist or engineer
- 4) Field analyses results
- 5) Analytical laboratory results
- 6) Copies of chain-of-custody forms

001972

TABLE 6-1
 SAMPLE IDENTIFICATION NUMBERS
 FOR SOIL SAMPLES COLLECTED FROM DEEPER
 AQUIFER OBSERVATION WELL INSTALLATION AT
 THE SOUTH CALVALCADE STREET SITE

<u>Sample Location Code Number(a)</u>	<u>Sample Identification Number</u>
SCK-OW-22	SCK-SL22A-001
	SCK-SL22A-002
	SCK-SL22A-003
	SCK-SL22A-004
SCK-OW-23	SCK-SL23A-001
	SCK-SL23A-002
	SCK-SL23A-003
	SCK-SL23A-004
Duplicate(b)	SCK-SL24A-001
Field Blank(c)	SCK-SL25A-001 through
	SCK-SLxxA-001(d)

-
- (a) Refer to Figure 6-1 for the location of deeper aquifer observation wells.
- (b) The location of the duplicate sample is to be selected in the field.
- (c) The location of the two field blanks is to be selected in the field.
- (d) As the exact number of sampling days are unknown, the 'xx' will be filled in with consecutive numbers following 25.

Contingency -- Should contamination of the deeper aquifer be found, installation of one or more additional wells may be required, as shall determination of the fundamental hydrologic behavior of the deeper aquifer system. In addition, installation of one or more wells to the next deeper aquifer may be required, as well as documentation of its use, hydrology, and quality. Monitoring beyond the one year period specified above may also be required. Furthermore, if the analytical results of soils materials indicate the presence of pentachlorophenol at concentrations greater than 1000 ppm, further field investigation should cease immediately, and the scope of work reevaluated and revised.

6.4.4 Groundwater Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Container</u>	<u>Volume</u>	<u>Preservative</u>
Volatile Organic Compounds	2 VOA Vials, Teflon-lined caps	2x40 ml	Cool 40C, protect from light
Acid and Base Neutral Fraction Mix, Pesticides and PCB	1 Glass Bottle Teflon lined cap	1 L.	Cool 40C, protect from light
Priority Pollutant Metals and Iron	Cubitainer	1 L.	HNO ₃ to pH 2, or less
Nitrates	Cubitainer	1 L.	Cool 40C

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control Plan for this investigation. Chain-of-Custody procedures for groundwater samples are addressed in Section 4.5 of the Quality Assurance/Quality Control Plan.

6.4.5 Groundwater Sample Identification/Numbering

A comprehensive listing of sample numbers for deeper groundwater samples is shown on Table 6-2 and is summarized as follows:

Ground water samples	6
Duplicate	1
Field Blanks	<u>2</u>
	9

Refer to Section 2.5 of this plan for a detailed description of the sample identification and numbering system.

6.5 Proposed Sampling Team

The following personnel are designated for the deeper groundwater investigation activity:

Field Coordinator - to be designated

Field Health and Safety Officer - to be designated

Field Technician(s) - to be designated

001975

TABLE 6-2
 SAMPLE IDENTIFICATION NUMBERS
 FOR DEEPER AQUIFER GROUNDWATER SAMPLES
 COLLECTED AT THE SOUTH CAVALCADE STREET SITE

<u>Sample Location Code Number(a)</u>	<u>Sample Identification Number</u>
CAV-OW-06	CAV-OW06-001
	CAV-OW06-002
SCK-OW-22	SCK-OW22-001
	SCK-OW22-002
SCK-OW-23	SCK-OW23-001
	SCK-OW23-002
Duplicate(b)	SCK-OW24-001
Field Blank(c)	SCK-OW25-001
	SCK-OW26-001

001976

(a) Refer to Figure 6-1 for locations of deeper aquifer observation wells.

(b) The location of the duplicate sample will be selected in the field.

(c) The location of the two field blanks will be selected in the field.

7.0 NONSOIL MATERIALS INVESTIGATION

In order to determine the character and degree of contamination, if any, of nonsoil material encountered on the South Cavalcade Street Site, and to facilitate evaluation of the disposition of these materials, a nonsoil materials investigation shall be conducted.

7.1 Methodology

Nonsoil materials encountered on the South Cavalcade Street Site that are related to past wood treating and wood preserving operations on the site or that appear to be abandoned and not directly under the control of or attributable to the current land owners shall be examined, characterized and sampled for indications of contamination using appropriate techniques.

7.2 Sampling Location

No specific sampling localities have been identified. The need to perform this subtask is dependent on the results of previously performed field investigation subtasks.

7.3 Analyses

Analyses of nonsoil materials shall be sufficient to determine the nature and the extent of their contamination and to assess the most feasible method of disposing of the materials. Engineering judgment is necessary in selecting the tests and analyses to be performed.

Deliverables --

- 1) Complete descriptions of all nonsoil materials encountered on the site
- 2) A map depicting the locations and extent of nonsoil material encountered on the site
- 3) Analytical laboratory results

001977

- 4) Copies of the field notes of the supervising geologist or engineer
- 5) Copies of the chain of custody forms

Contingency -- The review and guidance of EPA is essential in addressing the occurrence and contamination of nonsoil materials encountered on the South Cavalcade Street Site. Consultation with EPA is required in assessing what tests are necessary and whether exploration to completely determine the extent and degree of contamination of nonsoil materials is necessary. If the analytical results indicate the presence of pentachlorophenol at concentrations greater than 1000 ppm, further field investigations should cease immediately, and the scope of work reevaluated and revised with EPA guidance.

7.4 Proposed Sampling Team

The following personnel will be made available if the need to perform this subtask is identified:

Field Coordinator - to be designated

Field Health and Safety Officer - to be designated

Field Technician(s) - to be designated

001978

8.0 AIR QUALITY INVESTIGATION

Air samples will be taken in order to ascertain whether air emissions on the South Cavalcade Street site pose a hazard.

8.1 Sampling Frequency

Background air quality are to be obtained using a porous, polymer resin with solvent extraction and concentration prior to analysis. Samples are to be collected over a two-hour time interval on three consecutive days. On each day, one upwind sample and two downwind samples shall be collected. All samples are to be collected in duplicate. Air sampling will be conducted in the personnel work areas of the trucking firms.

8.2 Sampling Methodology

The sample procedure outlined in Appendix X will be followed when collecting air samples.

In order to establish background concentrations, one upwind and one downwind sample should be taken off-site as the designated field blanks.

The Health and Safety Plan for this investigation details health and safety procedures for air monitoring.

8.3 Sample Containers and Preservatives

<u>Specified Analysis</u>	<u>Container</u>	<u>Volume</u>	<u>Preservatives</u>
Polynuclear Aromatic Hydrocarbons	Resin filled glass cylinder	40 grams of resin	Cool 4°C, protect from light

Packaging, marking, and shipping of samples is addressed in Section 4.7 of the Quality Assurance/Quality Control Plan for this investigation.

8.4 Sample Identification and Numbering

A comprehensive listing of samples numbers for air quality samples is shown on Table 8-1, and may be summarized by the following:

Air Samples	9
Duplicates	9
Field Blanks	<u>3</u>
	21

8.5 Analysis

The analytical procedure outlined in Appendix X will be followed.

Deliverables --

- 1) Laboratory analyses
- 2) Chain-of-custody forms
- 3) Memorandum describing collection procedures and sampling localities and sampling times.

Contingency -- Should severe and extensive air emission hazards be encountered on the South Cavalcade Street Site, additional air quality studies may be necessary. These may include, but will not necessarily be limited to, installation of one or more air quality sampling stations and excavation of test pits for the purposes of investigating the emissions that might occur if soil or nonsoil contaminants are removed.

8.6 Proposed Sampling Team

The following personnel are designated for the air quality investigation activity:

Field Coordinator - to be designated
Field Health and Safety Officer - to be designated
Field Technician(s) - to be designated

TABLE 8-1
SAMPLE IDENTIFICATION NUMBERS FOR AIR
SAMPLES COLLECTED AT THE SOUTH CAVALCADE STREET SITE

<u>Sample Location</u>	<u>Sample Identification Number</u>
Upwind Day 1	SCK-AR01-001
Upwind Day 2	SCK-AR02-001
Upwind Day 3	SCK-AR03-001
Downwind Day 1	SCK-AR04-001
Downwind Day 1	SCK-AR04-002
Downwind Day 2	SCK-AR05-001
Downwind Day 2	SCK-AR05-002
Downwind Day 3	SCK-AR06-001
Downwind Day 3	SCK-AR06-002
Upwind Day 1 - Duplicate	SCK-AR01-002
Upwind Day 2 - Duplicate	SCK-AR02-002
Upwind Day 3 - Duplicate	SCK-AR03-002
Downwind Day 1 - Duplicate	SCK-AR04-003
Downwind Day 1 - Duplicate	SCK-AR04-003
Downwind Day 2 - Duplicate	SCK-AR05-003
Downwind Day 2 - Duplicate	SCK-AR05-003
Downwind Day 3 - Duplicate	SCK-AR06-003
Downwind Day 3 - Duplicate	SCK-AR06-003
Field Blank	SCK-AR07-001
Field Blank	SCK-AR08-001
Field Blank	SCK-AR09-001

001981

9.0 GEOPHYSICAL SURVEYING

A survey of the South Cavalcade Street site is to be conducted using geophysical instruments; surface resistivity, electromagnetics, ground penetrating radar, or some combination of the three. The purpose of the geophysical investigation is:

- 1) To provide supplemental subsurface information, particularly between existing bore holes.
- 2) To provide a means of better defining the configuration and attitude of important stratigraphic units beneath the site, and in particular, to identify subsurface irregularities in the shallow aquifer.
- 3) To provide a means of identifying potential concentrated accumulations of contaminants from the former wood preserving operations on the site, or any current operations on the site.
- 4) To provide information which may be used to alter or modify the subsurface sampling program and the shallow well installation program.

9.1 Sampling Locations

The location of the test plan will be a 150 ft. by 150 ft. square area located in the vicinity of Area 1 described in Section 4.1 of this plan. The test plan will also be located to include the known subsurface conditions of soil boring CAV-SL-03 (see Appendix I, Health and Safety Plan for Remedial Investigation, Koppers South Cavalcade Site, August 1985). This boring was part of a previous study undertaken at the site. The intent will be to locate the test plan area such that it covers a section of a suspected subsurface contamination (Area 1), incorporates the area and therefore the strata identified during the installation of CAV-SL-03 and extends far enough south to cover relatively uncontaminated subsurface soil.

Approximately 1200 linear feet of ground penetrating radar or electromagnetic traverses will be performed across the area with a 20 ft. spacing between traverses. A 50 ft. grid will be established in the test plan whereby 9 stations for earth resistivity soundings will be located.

9.2 Survey Methodology

Because of the uncertainty as to whether geophysical techniques (i.e. resistivity, electromagnetics, and ground penetrating radar) will produce usable information at the South Cavalcade Street site, the three techniques will be tested for utility and effectiveness.

It is anticipated that resistivity soundings will be performed first, followed by testing of the electromagnetics and ground penetrating radar. Should any, or some combination of the geophysical techniques prove effective, a plan to investigate the rest of the site will be developed and submitted to EPA for review. The effectiveness of these techniques in the test program will be evaluated based on their ability to accurately determine the known subsurface soil conditions found during the installation of CAV-SL-03, namely water table depth and depths of various soil strata. Also, the effectiveness will be evaluated based on their ability to detect expected anomolous subsurface conditions in Area 1.

Deliverables --

- 1) Contour and isopach maps and stratigraphic profiles of the soil materials of the shallow aquifer and other overlying materials.
- 2) Memorandum confirming or recommending alterations and modifications of the subsurface boring and well installation programs.

Contingency -- The geophysical investigation program described above is highly dependent on the success of the tests. The review and guidance of EPA with respect to the test results and the data gathered subsequently shall determine whether additional geophysical work should be carried out or whether further work may be eliminated.

9.3 Proposed Surveying Team

The following personnel are designated for the geophysical surveying activity:

Field Coordinator - to be designated
Field Health and Safety Officer - to be designated
Geophysical Subcontractor - to be designated

The geophysical subcontractor will be selected based on general subcontractor procurement criteria detailed in Section 4.2 of the Quality Assurance/Quality Control Plan for this investigation. Specifically, the experience of the geophysical subcontractor will be evaluated based on:

- (1) Number, size and degree of difficulty of past survey projects.
- (2) Project experience related to specific contaminants of interest (polynuclear aromatic hydrocarbons).
- (3) Contacting selected references provided by the subcontractor to evaluate past project performance.

001984

APPENDIX I
SOP 7120 SURFACE WATER SAMPLING

001985

STANDARD OPERATING PROCEDURE

Title: Surface-Water Sampling Techniques

Number: 7120

1.0 Applicability

This Standard Operating Procedure (SOP) defines the basic techniques and general considerations to be followed for the collection of water-quality samples from rivers, lakes and ponds. The specific details of actual sample collection are highly dependent upon local conditions as well as upon the purpose of the water quality study. Nevertheless, certain aspects of sample collection procedures are independent of project-specific variations.

2.0 Responsibilities

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The sampling program will identify the general sampling location(s), frequency, sample type (grab or composite), water-quality parameters and analytical procedures. The field team is responsible for familiarizing themselves with the sampling program, and ensuring that all field equipment is in proper operating condition and that the appropriate sample containers and preservatives are available. The field team is also responsible for proper sample handling as specified in SOP 7510, Handling and Storage of Samples.

3.0 Materials

- Project specific sampling program
- Site area maps (e.g., USGS 7-1/2 minute or 15 minute quadrangle topographic maps)
- Sample containers and preservatives
- Insulated containers (e.g., coolers) for sample storage and an ample supply of ice
- Field equipment as specified in the sampling program and the corresponding manufacturer's manuals.
- Calibration standards for field equipment
- Alpha horizontal type sample collector (for deep rivers, lakes and ponds)
- Boat or raft (for deep rivers, lakes and ponds)
- Weighted tape measure or rigid gage
- Field-data sheets and/or log book
- First aid kit

STANDARD OPERATING PROCEDURE

Title: Surface-Water Sampling Techniques

Number: 712C

4.0 Procedures

4.1 Sample Location Selection

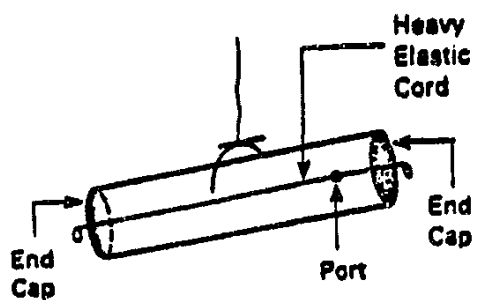
The selection of the precise sampling location requires professional judgment and an understanding of the purpose of the study. Sampling locations where mixing is incomplete should be avoided if an average composition is required. Often, areas of poor lateral or vertical mixing can be visually identified. For example, color or turbidity differences may be apparent immediately below the confluence of a tributary and the main river or at a wastewater discharge point. Use of a field conductivity meter is recommended for determining the uniformity of the water composition across the width and depth of the water body. Once the sampling point has been selected, it must be fixed by detailed description, maps, or with the aid of stakes, buoys, or other landmarks so that others can identify the sampling location.

4.2 Stream Sampling

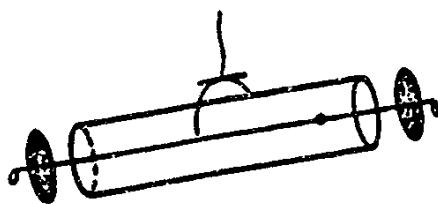
- 4.2.1 In shallow streams (those which can be safely traversed on foot) the sample container can be filled directly with the flowing water. Unless otherwise specified in the project sampling program, sample should be collected at mid-depth in the mid-section or deepest flow channel of the stream.
- 4.2.2 In deep rivers, use of a boat or raft will usually be required to obtain a representative sample. As with shallow streams, samples should be obtained at mid-depth in the mid-channel unless otherwise specified in the sampling program. Stream depth can be determined using a depth sounder or by physical measurement with a heavily weighted flexible measuring tape or a rigid gage.
- 4.2.3 An Alpha horizontal type sampler should be used for collecting samples at a specific depth in the water column. Figure 1 illustrates the operation of one of these samplers.

4.3 Lake and Pond Sampling

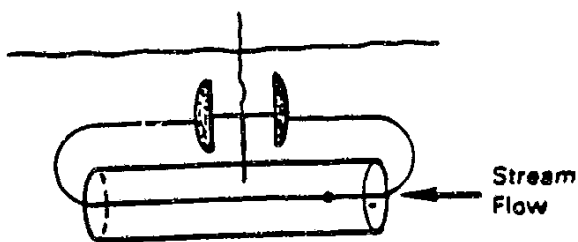
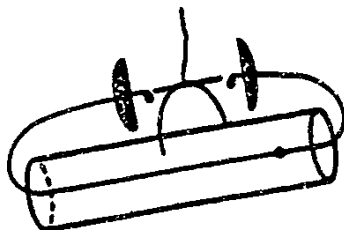
- 4.3.1 Water in lakes and ponds is generally poorly mixed and thermal stratification is frequently observed. Single samples can only represent the specific spot from which they were obtained. For many studies, samples taken at the inlet(s) and/or outlet of the lake or pond are of the most interest. In other studies, a grid is established over the lake or pond and samples are collected at grid-line intersections.



Sampler in Closed Position



Sampler Being Prepared for Sample Collection



Sampler in Place for Sample Collection



End Caps Shut via Quick Release Mechanism and Sample is Obtained

Figure 1 Alpha Horizontal Type Sampler

STANDARD OPERATING PROCEDURE

Title: Surface-Water Sampling Techniques

Number: 712C

4.3.2 As with deep rivers, an Alpha horizontal type sampler should be used for sample collection.

4.4 Sample Handling and Preservation

4.4.1 In general, the shorter the time lapse between sample collection and analysis, the more reliable the results will be. Certain water-quality parameters, especially pH, temperature and dissolved oxygen, are so closely related to the environment of the water that meaningful results can only be obtained by in-situ field measurements.

4.4.2 EPA has developed a list of recommended sample containers, preservatives and maximum holding times for water quality measurements (see Federal Register 44:69464). Unless otherwise specified in the sampling program, this list should be followed. Preservatives may be added to the sample containers in the field after filling, or the containers can be pre-spiked with the preservative. All samples should be placed on ice immediately after collection and should remain iced until delivery to the analytical laboratory.

5.0 Documentation

A record must be kept of every sample collected and every bottle must be clearly marked, preferably with a waterproof label. An example field-data sheet is provided in Figure 2. Project-specific data sheets or log books may be used. The field record must provide positive sample identification as well as the name of the sample collector, the date, time and exact location of the sample collection point, and results of all field water quality measurements. Other information such as weather and stream-flow conditions should also be noted. All documentation will be retained in the appropriate project files.

APPENDIX II
SOP 7600 DECONTAMINATION

001991

Title: Decontamination

STANDARD OPERATING PROCEDURE

Page 9f 4

Date: 1st Qtr 19
Number: 7600
Revision: 1

1.0 General Applicability

This SOP describes the methods to be used for the decontaminization of all field equipment which becomes potentially contaminated during a sample collection task. The equipment may include split spoons, bailers, trowels, shovels, hand augers, or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross-contamination between samples and also helps to maintain a clean working environment for the safety of all field personnel involved, including the environment.

Decontamination is mainly achieved by rinsing with liquids which include: soap and/or detergent solutions, tap water, deionized water, and methanol. Equipment will be allowed to air dry after being cleaned or may be wiped dry with chemical free cloths or paper towels if immediate re-use is needed. Steam cleaning only, can be used whenever possible.

The frequency of equipment use, dictates that most decontamination be accomplished at each sampling site between collection points. Waste products produced by the decontamination procedures such as waste liquids, solids, rags, gloves, etc. will be collected and disposed of properly based on the nature of contamination. All cleaning materials and wastes should be stored in a central location so as to maintain control over the quantity of materials used and/or produced throughout the study.

2.0 Responsibilities

It is the primary responsibility of the site operations manager to assure that the proper decontamination procedures are followed and that all waste materials produced by decontamination are properly stored and disposed of.

It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Project Health and Safety Plan.

It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that any contaminants are not negligently introduced to the environment.

STANDARD OPERATING PROCEDURE

Title: Decontamination

Page 2 of 4
Date: 1st Qtr 1976
Number: 7600
Revision: 1

3.0 Supporting Materials

- cleaning liquids: soap and/or detergent solutions, tap water, deionized water, methanol
- personal safety gear (defined in Project Health and Safety Plan)
- chemical-free paper towels
- disposable gloves
- waste storage containers: drums, boxes, plastic bags
- cleaning containers: plastic buckets, galvanized steel pans
- cleaning brushes

4.0 Methods or Protocol for Decontamination

4.1 General Procedures

- 4.1.1 The extent of known contamination will determine to what extent the equipment needs to be decontaminated. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated until enough data are available to allow assessment of the actual level of contamination.
- 4.1.2 Adequate supplies of all materials must be kept on hand. This includes all rinsing liquids and other materials listed in Section 3.0.
- 4.1.3 The standard procedures listed in the following section can be considered the procedure for full field decontamination. If different or more elaborate procedures are required for a specific project, they will be spelled out in the project work plan. Such variations in decontamination may include following all, just part, or an expanded scope of the decontamination procedure stated herein.

4.2 Standard Procedures

- 4.2.1 Remove any solid particles from the equipment or material by brushing and then rinsing with available tap water. This initial step is performed to remove gross contamination. For drilling equipment only, steam cleaning will be necessary.

001993

Title: Decontamination

STANDARD OPERATING PROCEDURE

Page 3 of 4

Date: 1st Qtr 19
Number: 7600
Revision: 1

- 4.2.2 Wash equipment sampler with the soap or detergent solution.
- 4.2.3 Rinse with tap water
- 4.2.4 Rinse with deionized water, if necessary
- 4.2.5 Rinse with methanol, if necessary
- 4.2.6 Repeat entire procedure or any parts of the procedure if necessary
- 4.2.7 Allow the equipment or material to air dry before re-using
- 4.2.8 Dispose of any soiled materials in the designated disposal container

5.0 Specific Decontamination Procedures

5.1 Submersible Pump

5.1.1 Applicability

This procedure will be used to decontaminate submersible pumps between ground-water sample collection points and at the end of each day of use.

5.1.2 Materials

- o plastic-nalgene upright cylinder
- o 5-10 gallon plastic water storage containers
- o methanol and dispenser bottle
- o deionized water and dispenser bottle
- o chemical free paper towels

5.1.3.1 During decontamination the submersible pump will be placed on a clean surface or held away from ground.

5.1.3.2 When removing the submersible pump from each well the power cord and discharge line will be wiped dry using chemical-free disposable towels.

5.1.3.3 Clean the upright plastic-nalgene cylinder with first a methanol and then a deionized water rinse, wiping the free liquids after each.

Title: Decontamination

STANDARD OPERATING PROCEDURE

Page 4 of 4
Date: 1st Qtr 19
Number: 7600
Revision: 1

- 5.1.3.4 Reverse pump backwashing all removable residual water present in the pump tubing. The pump should be shut off as soon as intermittent flow is observed from the reverse discharge.
 - 5.1.3.5 Rinse the stainless steel submersible down hole pump section with a liberal application of methanol and wipe dry.
 - 5.1.3.6 Place the submersible pump section upright in the cylinder and fill the cylinder with tap water, adding 50-100 ml of methanol for every one liter of water.
 - 5.1.3.7 Activate the pump in the forward mode withdrawing water from the cylinder.
 - 5.1.3.8 Continue pumping until the water in the cylinder is pumped down and air is drawn through the pump. At this time air pockets will be observed in the discharge line. Shut off the pump immediately.
 - 5.1.3.9 Remove the pump from the cylinder and place the pump in the reverse mode allowing that all removable water be discharged on to the ground surface as discussed in Step 2.
 - 5.1.3.10 Using the water remaining in the cylinder, rinse the sealed portion of the power chord and discharge tube by pouring the water carefully over the coiled lines.
 - 5.1.3.11 When reaching the next monitoring well place the pump in the well casing and wipe dry both the power and discharge lines with a clean paper towel as the pump is lowered.
- 5.1.4 Quality Assurance

To assure that decontamination is complete, field blank samples shall be collected using the cleaned submersible pump. These field blanks will be subsequently analyzed for the parameters of interest with respect to the ground water.

The procedure for collecting the field blanks will comprise using the pump to withdraw the tap water used for decontamination, from the plastic cylinder to sample containers. This field blank sample collection procedure shall only be performed after the materials to be used have been decontaminated.

APPENDIX III
FEDERAL REGULATION 40 CFR,
PART 265, SUBPART I

001996

Federal Regulations 40CFR, Part 265, Subpart I

Subpart I—Use and Management of Containers

§ 265.170 Applicability.

The regulations in this Subpart apply to owners and operators of all hazardous waste facilities that store containers of hazardous waste, except as § 265.1 provides otherwise.

§ 265.171 Condition of containers.

If a container holding hazardous waste is not in good condition, or if it begins to leak, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition, or manage the waste in some other way that complies with the requirements of this Part.

§ 265.172 Compatibility of waste with container.

The owner or operator must use a container made of or lined with materials which will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired.

§ 265.173 Management of containers.

(a) A container holding hazardous waste must always be closed during storage, except when it is necessary to add or remove waste.

(b) A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.

[Comment: Re-use of containers in transportation is governed by U.S. Department of Transportation regulations, including those set forth in 49 CFR 173.28.]

[265.173 comment revised by 45 FR 78529, November 25, 1980]

§ 265.174 Inspections.

The owner or operator must inspect areas where containers are stored, at least weekly, looking for leaks and for deterioration caused by corrosion or other factors.

[Comment: See § 265.171 for remedial action required if deterioration or leaks are detected.]

§ 265.175 [Reserved]

§ 265.176 Special requirements for ignitable or reactive waste.

[Interim final]

Containers holding ignitable or reactive waste must be located at least

15 meters (50 feet) from the facility's property line.

[Comment: See § 265.17(a) for additional requirements.]

§ 265.177 Special requirements for incompatible wastes.

(a) Incompatible wastes, or incompatible wastes and materials, (see Appendix V for examples) must not be placed in the same container, unless § 265.17(b) is complied with.

(b) Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material (see Appendix V for examples), unless § 265.17(b) is complied with.

(c) A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.

[Comment: The purpose of this is to prevent fires, explosions, gaseous emissions, leaching, or other discharge of hazardous waste or hazardous waste constituents which could result from the mixing of incompatible wastes or materials if containers break or leak.]

§ 265.178-265.189 [Reserved]

001997

APPENDIX IV
FLOW MEASUREMENT BY FLOAT METHOD

001998

Flow Measurement by Float Method (a)

Floats have very limited use in stream gaging, but there are two occasions when they prove useful. A float can be used where the velocity is too low to obtain reliable measurements with the current meter. They are also used where flood measurements are needed and the measuring structure has been destroyed or it is impossible to use a meter.

Both surface floats and rod floats are used. Surface floats may be almost anything that floats, such as wooden disks, bottles partly filled, or oranges. Rod floats are wooden rods weighted on one end so they will float upright in the stream. Rod floats must not touch the streambed. Floating debris or ice cakes may serve as natural floats.

Two cross sections are selected along a reach of straight channel for a float measurement. The cross sections should be far enough apart so that the time the float takes to pass from one cross section to the other can be measured accurately. A traveltime of at least 30 seconds is recommended, but a shorter time can be used on small streams with high velocities, where it is impossible to select an adequate length of straight channel.

The procedure for a float measurement is to distribute a number of floats uniformly over the stream width, noting the position of each. They should be allowed to reach a constant velocity before timing by stopwatch the interval each takes to travel between two cross sections. The distance of each float from the bank as it passes each cross section should also be noted.

The velocity of the float is equal to the distance between the cross sections divided by the time of travel. Care must be taken when measuring low velocities, that the floats are not being affected by wind. The mean velocity of flow in the vertical is equal to the float velocity multiplied by a coefficient which is based on the shape of the vertical-velocity profile and relative depth of immersion of the float. A coefficient of about 0.85 is commonly used to convert surface velocity to mean velocity. The coefficient for rod floats varies from 0.85 to 1.00 depending on the shape of the cross section and the velocity distribution.

The discharge in each partial section is computed by multiplying the average area of the partial section by the mean velocity in the vertical for that partial section. The total discharge is equal to the sum of the discharges for all the partial sections.

Float measurements can be made with an accuracy within 10 percent under good conditions and when a certain amount of care is exercised. If a poor reach is selected and not enough float runs are made, the results can be as much as 25 percent in error.

- (a) From "Techniques of Water Resources Investigation of U.S. Geological Survey, Chapter A8: Discharge Measurements at Gaging Station." Buchanan, Thomas J.; Somers, William P., 1969

APPENDIX V
SOP 7140 LAKE AND STREAM-BOTTOM
SEDIMENT SAMPLING

002000

STANDARD OPERATING PROCEDURE

Title: Lake and Stream-Bottom Sediment Sampling

Number:

7140

1.0 General Applicability

This Standard Operating Procedure (SOP) describes the methods to be used to obtain representative samples from lake and stream-bottom sediments. Lake and stream-bottom sediment sampling is performed to define the chemical and in some cases physical or biological composition of sediment. Sediment sampling is nearly performed to delimit the extent of chemical contamination within water systems.

Sediment or benthic material may be obtained directly from small streams using trowels or small shovels or from lake and ponds using dredge/clam shell-type samplers.

Sediment samples collected for organic analyses when possible should be collected from finer sediments such as silts and clay. To collect such samples, sampling sites will be selected consisting of sediment deposition areas where silt and clay settle out due to low current speeds. Samples for organic chemical analyses should not be collected from areas exposed during low flow or low tide conditions or in areas immediately downgradient of the confluence of two streams.

2.0 Equipment Descriptions

Shovel - long or short handle with steel blade. Applicable for small streams and brooks where the average depth of flow is one foot or less. Primarily used where representative samples can be collected from the stream bank or by wading.

Trowel - basic garden type which resembles a small shovel. Constructed of steel or plastic. Primarily applicable for small streams having a depth of one foot or less where samples may be collected from the bank or by wading.

Dredge - Ponar® type plated steel grab dredge. Applicable for bottom sampling where wading is not possible and water depths are greater than two (2) feet. Often used from boat or raft and is always lowered with a rope or cable.

3.0 Responsibilities

It is the primary responsibility of the project manager to assure that a sampling program is designed which will provide an adequate characterization of surface water sediments. With respect to sample collection procedures, it will be the responsibility of the site operations/field work coordinator to provide that all sediment samples are collected in accordance with this SOP and the site specific sampling protocol.

4.0 Supporting Materials

- o Project Specific Sampling Program
- o Sediment Sample Log
- o Deionized water dispenser rinse bottle

STANDARD OPERATING PROCEDURE

Title: Lake and Stream-Bottom Sediment Sampling

Number:

714

- Methanol dispenser rinse bottle
- Chemical free paper towels
- Sample logs
- Sample containers/labels
- Six-foot folding rule
- 100 foot tape measure
- Goggles/eye protection
- Wader-type rubber boots (shallow streams)
- Boat or raft (deep rivers and lakes)
- Plastic spoons
- Plastic or galvanized steel basin

5.0 Method or Protocol

5.1 General Procedure

Sediment samples will be collected from the upper one-half foot of bottom sediment. Samples from small streams will be collected either from the bank or by wading into the stream. Sediment samples from ponds, lakes or large rivers will be collected from a boat or raft so that a position can be established areally for adequate characterization of sediment composition.

Samples will be collected and immediately placed in the sample containers appropriate for the analyses to be performed. Sample containers for most analyses will be placed in standard glass jars. Samples for volatile organic compound analysis will be placed in VOA vials. The types of cap liners used will depend on the analyses to be performed. For all sampling applications except metals analyses teflon cap liners will be used. For metals analyses, teflon or plastic cap liners will be used.

5.2 Standard Procedures

- 5.2.1 Consult the project sampling program and select the sample location. Record the sample point orientation on a map or plan of the stream, brook or lake.
- 5.2.2 Using the weighted measuring tape, obtain a measurement to the bottom of the stream, river or pond. Enter the depth on the Sediment Sample Log shown in Table 1.
- 5.2.3 Use appropriate sampler (i.e., shovel, trowel, or dredge) to sample sediment.
- 5.2.4 At the completion of work at each sediment sample point, the sampling materials (i.e., trowels, shovels, dredges and basin) must be decontaminated prior to the start of sampling at the next point. All decontamination procedures shall be performed in accordance with the SOP 7600 Decontamination.

STANDARD OPERATING PROCEDURE

Title: Lake and Stream-Bottom Sediment Sampling

Revision: 714'

6.0 Documentation

A field notebook will be maintained into which all observations during sampling will be entered. In addition, a Sediment Sample Log will be completed for each point.

All sample volumes and bottle types will be noted and all bottles will be labeled at the point of collection. Chain-of-custody forms will be completed for each group of samples, by container, prior to transport off-site and at a minimum at the end of each field day.

7.0 References

EPA, Handbook for Sampling and Sample Preservation of Water and Wastewater
EPA-600/4-82-029, September, 1982

002003

STANDARD OPERATING PROCEDURE

Page of

Title:

Date:
Number:
Revision:

TABLE 1
SEDIMENT SAMPLE LOG

PROJECT NO. _____

PROJECT LOCATION _____

SAMPLE POINT NO. _____

DATE _____

SAMPLE POINT DESCRIPTION/DESIGNATION _____

TYPE OF SURFACE WATER SOURCE _____

DEPTH OF SURFACE WATER @ SAMPLE POINT _____

DESCRIPTION OF SEDIMENT SAMPLE (include; estimation of organic/inorganic fraction,
presence of humic material, color, oil film, odor etc

REMARKS _____

INSPECTOR'S NAME _____

APPENDIX VI

SOP 7315 OPERATION/CALIBRATION HNU
PHOTOIONIZATION ANALYZER

002005

STANDARD OPERATING PROCEDURE

Title: Operation/Calibration HNU Photoionization Analyzer

Page 1 of 6

Date: 1st Qtr

Number: 7315

Revision: 1

1.0 General Applicability

This SOP describes the operation and calibration techniques used for the Model PI 101 Photoionization Analyzer, manufactured by HNU Systems, Inc. This instrument is designed to measure organic vapor levels. There are three direct reading ranges: 0-20 ppm, 0-200 ppm and 0-2000 ppm at a minimum gain. The detection limits is 0.1 ppm. The linear range is 0-600 ppm. The response time is less than 5 seconds to 90% of full scale. (All specifications are benzene referred).

The PI 101 is capable of operating either from a rechargeable battery for more than 10 hours or continuously from the AC battery charger. The recorder output is 0-100 MV FSD (full scale deflection).

2.0 Responsibilities

- 2.1 The project geologist or engineer will be responsible for the calibration, operation and maintenance of the instrument.
- 2.2 The geologist or engineer and/or field coordinator will be responsible for the documentation which applies to the various procedures performed with the instrument.

3.0 Supporting Materials

- NBS - Traceable span gas cylinders:
 - 10 ppm Isobutylene in Z-1 air, CGA590
 - 150 ppm Isobutylene in Z-1 air
- Tedlar bags
- Tubing used for gas transfer from cylinder to bag (if necessary)
- AC battery charger
- "magic marker"
- appropriate forms
- activated charcoal

4.0 Methods or Protocol for Use

4.1 Standard Procedure

STANDARD OPERATING PROCEDURE

Title: Operation/Calibration HNu Photolonization Analyzer

Page 2 of 6
Date: 1st Qtr 19
Number: 731
Revision: 1

- 4.1.1 Operation and calibration of the instrument should be done in a controlled environment; i.e., in the field office, interior of vehicle, etc. This is done in order to control working temperature, and to protect from vehicle exhausts, etc.
- 4.1.2 The probe nozzle, electrode casing handle, and cable are stored within the instrument cover. To assemble, the handle must be screwed to the electrode casing. The probe nozzle must be screwed to the opposite end of the electrode casing. The 12-pin connector at the end of the cable must then be attached to the rest of the unit by twisting it downwards until a distinct snap and lock is felt. The unit is now ready to be used.
- 4.1.3 Prior to calibration or use of the instrument the unit should be allowed to warm up for up to one-half hour. In this time, check to see if the UV light source is working. Do not look directly at the light source. Also check to see if the intake fan is working properly. It is within the electrode casing and will give off a distinct hum when the unit is turned on.
- 4.1.4 Check to make sure the level of charge is high enough to ensure accurate readings. When the instrument is switched to the BATTERY CHECK position, the needle should deflect upscale to well within the green area (battery level) on the face of the meter. If not, the unit should be charged using the AC charger. A 3-hour charge will bring the unit up 90% full charge. With continuous use, (e.g., unit left on for a full day), the unit should be recharged overnight for 8-10 hours.

4.2 Calibration and Maintenance

- 4.2.1 Calibration should be done at the beginning of each day the instrument is used, to ensure accurate readings over the full range of scale that is to be needed. Two cylinders containing Isobutylene of two different, known concentrations are to be used as calibration gases. If only one cylinder is available, it should be of high enough concentration to be within the expected range under normal use.

STANDARD OPERATING PROCEDURE

Title: Operation/Calibration HNu Photoionization Analyzer

Page 3 of 6

Date: 1st Qtr 1
Number: 7315
Revision: 1

- 4.2.2 The instrument should be given the dynamic zero check by connecting the activated charcoal cannister to the inlet probe, using flexible tubing, while operating the instrument in the sampling mode. Wait for a stable response, and then adjust the zero potentiometer until a zero reading is obtained. This zero check should be performed before and after each calibration. The charcoal in the cannister should be replaced at least once every 5 sampling days.
- 4.2.3 Actual calibration is done by first filling an evacuated Tedlar bag with gas from the calibration gas cylinder containing the highest gas concentration. Use the available tubing and any other hookup materials that are provided. Be absolutely sure that the Tedlar bag has been evacuated before filling it with gas. Otherwise the calibration gas will be diluted and its concentration will not be known.
- 4.2.4 The appropriate analyzer scale should be chosen depending on the known concentration of the calibration gas. Attach the probe nozzle to the Tedlar bag and allow it to sample the gas until a stable, unchanging reading is reported by the analyzer. Adjust the span potentiometer so that the instrument reading agrees exactly with the concentration the calibration gas. Whenever the span setting is changed the zeroing procedure (Section 4.2.2) should be repeated.
- 4.2.5 The calibration procedure should be repeated for the other calibration gas provided to ensure that the instrument is calibrated properly over a wide range of scale.
- 4.2.6 All calibration checks must be documented on the appropriate forms (calibration form, equipment status form).

4.3 Standard Operation

- 4.3.1 After the instrument is fully calibrated it is ready to be used. To obtain the most accurate reading, the lowest possible scale should be selected prior to sampling. To analyze a sample, the probe nozzle should be placed in close proximity to the sample taking care not to contaminate the probe with any materials (soil, water).
- 4.3.2 All readings should be documented on the appropriate forms (sample log, sample container label).

STANDARD OPERATING PROCEDURE

Title: Operation/Calibration HNU Photoionization Analyzer

Date: 1st Qtr 1975
Number: 7315
Revision: 1

4.3.3 A "magic marker" is provided to check meter response periodically. When the probe is inserted into the marker cap or next to the marker tip a reading of about 5 ppm should be obtained. Shelter the probe and marker from any wind when performing this test.

4.3.4 Meter calibration should be checked by the methods in 4.2 at the end of the day, and any appropriate changes made and documented.

5.0 Documentation

5.1 Field/Lab equipment status form

5.2 HNU PI 101 recalibration form

5.3 All documentation shall be retained in the project files.

6.0 References

Instruction Manual for Model PI 101 Photoionization Analyzer, printed by HNU Systems, Inc., 1975.

002009

STANDARD OPERATING PROCEDURE

Title: Operation/Calibration HNU Photoionization Analyzer

Date: 1st Qtr 1
Number: 7315
Revision: 1

HNU PI 101 RECALIBRATION FORM

Project Name/No. _____ Recalibration Date ____/____/____

Time _____

By Whom _____ (Init)

Calibration Gases: Cylinder ID Number _____ Concentration _____

1. _____ ppm

2. _____ ppm

Where Recalibrated: _____

(office, field lab)

Battery Check: (Y, N) _____

Recharge Time: _____ hrs

Zero Adjust: (Y, N) _____

002010

First Calibration:
(use higher standard gas)

Designated Reading _____ ppm

Observed Reading _____ ppm

Span Setting: Initial _____
Final _____

Post Span Observed Reading _____ ppm

Post Calibration Zero Adjust: (Y, N) _____

Second Calibration
(use lower standard)

Designated Reading _____ ppm

Observed Reading _____ ppm

Final Zero Adjust: (Y, N) _____ Second Recalibration Needed (Y, N) _____

Calibrated By: _____

Date: ____/____/____

STANDARD OPERATING PROCEDURE

Title: Operation/Calibration HNu Photoionization Analyzer

Date: 1st Qtr 19:
Number: 731r
Revision: 1

FIELD/LAB EQUIPMENT STATUS FORM

Type of Equipment _____

Equipment No. _____ Mfr. _____

Date	Calibration/ Maintenance (C. M.)	Agent Used	Adjustments Made		Status (OK, Hold)	Initial
			What Type	Initial Final		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Additional Comments:

APPENDIX VII

SOP 7115 SUBSURFACE SOIL SAMPLING

SOP 7210 ROCK-CORE DRILLING

SOP 7211 LOGGING OF ROCK CORES

002012

STANDARD OPERATING PROCEDURE

Title: Subsurface Soil Sampling

Page 1 of 1
Date: 1st Qtr
Number: SOP 71
Revision: 1

1.0 General Applicability

This SOP describes the methods used in obtaining subsurface soil samples for identification of soil grain-size distributions, stratigraphic correlations, and chemical analysis (if required). Subsurface soil samples are obtained in conjunction with soil boring and monitoring-well installation programs and provide direct information as to the physical makeup of the subsurface environment. This SOP covers subsurface soil sampling by split-spoon only, as this is the means most often used for obtaining samples from unconsolidated deposits. (See also, SOP 7220 - Monitoring Well Construction).

2.0 Responsibilities

It shall be the responsibility of the contract driller to provide the necessary materials for obtaining subsurface soil samples. This includes the split-spoon sampler and sample containers (sized according to project requirements) as well as the appropriate boring logs. It is the contract driller's responsibility to maintain a complete set of boring logs for contract purposes. Standard Penetration Tests (SPT) (ASTM: 1586-67) will be conducted by the contract driller if required by the project. Equipment decontamination shall also be the responsibility of the driller.

It shall be the responsibility of the project geologist/engineer to observe all activities pertaining to subsurface soil sampling to ensure that all the standard procedures are followed properly, and to record all pertinent data on boring log. It is also the geologist/engineer's responsibility to indicate to the contract driller at what specific depth samples shall be collected. The geologist/engineer will maintain custody of all samples until they are shipped to their appropriate destination.

3.0 Supporting Materials

In addition to those materials provided by the contract driller, the geologist/engineer will provide:

- o analytical sample bottles and labels
- o boring logs
- o field notebook
- o chain-of-custody forms

STANDARD OPERATING PROCEDURE

Page 2 of 5
Date: 1st Qtr
Number: SOP 7
Revision: 1

Title: Subsurface Soil Sampling

4.0 Methods or Protocol for Use

4.1 General Procedures

The sampling depth interval is typically one (1) sample per every five (5) vertical feet with additional samples taken, at the discretion of the project geologist/engineer, when significant textural, visual or odor changes are encountered.

The following are the standard procedures to be used in advancing casing and obtaining soil samples.

Specific requirements described in a project's task plan may call for deviation in the standard procedures but these will be taken into account on a project by project basis. Any deviations from specified procedures will be recorded on the boring log.

4.2 Standard Procedures - Advancing Casing

- 4.2.1 The casing shall be advanced to the required depth. All loose material within the casing shall be removed prior to sampling. The casing shall be advanced according to project requirements. Borings are typically advanced by two methods, drive-and-wash casing, and hollow-stem augering. The casing shall be of the flush joint or flush couple type and of sufficient size to allow for soil sampling, coring, and/or well installation. All casing sections shall be straight and free of any obstructions. Hollow-stem augers or solid flight augers with casing may be used according to specific project requirements as described in the project task plan. If hollow-stem augers are to be used, the bit shall be equipped with a plug device to be removed at the required sampling depth.
- 4.2.2 For those borings which encounter obstructions, the casing shall be advanced either past or through the obstruction by drilling, mechanically fracturing, or blasting (if required). If the obstruction is bedrock, a rock core shall be taken according to project requirements and following the standard procedures for rock coring (SOP # 7210).
- 4.2.3 The use of recirculated water shall not be permitted when casing is being driven, unless specified in the project task plan, directed a properly documented by the geologist/engineer.
- 4.2.4 If recirculated water is used all loose material within the casing shall be removed by washing to the required sampling depth using a minimum amount of water. Care shall be taken to limit recirculation of the wash water to those times when the water supply is extremely limited or unavailable.

STANDARD OPERATING PROCEDURE

Page of
3 5

Title:
Subsurface Soil Sampling

Date:
Number: 1st Qtr :
Revision: SOP 71:
1

4.3 Standard Procedures - Soil Sampling

- 4.3.1 Subsurface soil samples shall be obtained using a split-tube type sampler (split spoon) having a 2-inch O.D. with a corresponding 1 3/8-inch I.D. and a 24-inch long sample capacity. It shall be equipped with a ball check valve and will require a flap valve or basket-type retainer for loose-soil sampling. Sampling frequency will be as stated in Section 4.1, or as otherwise specified in the project task plan.
- 4.3.2 Sampling depth shall be independently determined by the inspecting geologist, and any discrepancies shall be resolved prior to obtaining the sample.
- 4.3.3 Samples shall be obtained using the standard penetration test (SPT), which allows for determination of resistance within the deposits. The sampler shall be driven using a 140-pound hammer with a vertical drop of 30-inches using 1 to 2 turns of the rope on the cathead. A certificate indicating exact weight may be required for documentation purposes. The number of hammer blows required for every 6 inches of penetration shall be recorded on the boring log.
- 4.3.4 The sampler shall be immediately opened upon removal from the casing. If the recovery is inadequate, another attempt shall be made before drilling progresses. Adequate recovery should be no less than 12 inches, not including any residual wash material brought up with the sample.
- 4.3.5 The sample shall be split if necessary, placed in the appropriate container, labelled, and placed in the storage box. The boring log and the sample container/label should contain the following information for each sample: site name, boring location, depth, blow counts, recovery, sample number and collection date. The type of material shall be indicated in the boring logs and will be described using the Unified Soil Classification System (ASTM: D2487-69 and D2488-69).
- 4.3.6 The sampler shall be cleaned with water between attempts in order to prevent cross-contamination. If further decontamination is required SOP 7600 shall be consulted.
- 4.3.7 Proper procedures for delivery to the designated laboratory shall be initiated when all samples are collected. This includes packaging, shipping with sample logs, analysis request forms, and chain of custody forms.

STANDARD OPERATING PROCEDURE

Title: Subsurface Soil Sampling

Page 4 of 5
Date: 1st Qtr
Number: SOP 7
Revision: 1

5.0 Documentation

Various forms are required to ensure that adequate documentation of each sample is followed and will include:

- sample logs
- boring logs
- chain of custody forms
- shipping forms

In addition, a field log book will be kept as an overall log of all samples collected throughout the study. All documents are retained in the appropriate project files indefinitely.

0020

[illegible]

STANDARD OPERATING PROCEDURE

Page of 1

Title: Rock-Core Drilling

Date: 1st Qtr
Number: 7210
Revision: 1

1.0 Purpose and Applicability

This SOP describes the methods used for obtaining rock core samples for establishing the stratigraphy, structure, and geotechnical properties of the rock.

2.0 Responsibilities

It is the responsibility of the contract driller to provide the necessary equipment for coring and to collect the designated samples.

It is the responsibility of the project geologist/engineer to observe the coring operation and to log all cores that are collected using the approved forms.

3.0 Supporting Materials

All drill rigs used for rock coring shall be equipped with hydraulic feed. Driven or drilled-in flush joint casing shall be employed. For driven casing, it may not be necessary to record the casing blows. Drill rods for drilling rock should be MW in size to minimize vibration and chattering. Rock core size shall be NX or NQ (Wire Line) or as required by the Project Task Plan. Core barrels shall be of the improved double-tube varieties such as the Christensen Series C or D models or equivalent, and shall be equipped with a split inner tube. In general, 5-foot barrels will be employed at the discretion of the inspecting geologist.

Core boxes shall be provided by the contract driller for storage purposes.

4.0 Coring Procedures

4.1 General Information

4.1.1 Typically, soil sampling and rock coring will be performed in the same borehole. Casing shall be required for the full depth of the overburden in borings in which rock will be cored.

4.1.2 The inspecting geologist may allow the use of drilling mud to advance the boring for unusual combinations of soil and ground-water conditions. Prior to commencing rock drilling, however, casing shall be inserted in the mudded hole and firmly seated in rock. Biodegradable drilling fluids such as Johnson's Revert shall be used. Other fluids, such as bentonite slurry, is subject to the approval of the project geologist or his delegate.

4.2 Procedure

4.2.1 Casing shall be firmly seated into the bedrock surface prior to commencing rock drilling. The drilling methods employed shall be adjusted continuously to obtain maximum core recovery of the rock

STANDARD OPERATING PROCEDURE

Page of 3

Title: Rock-Core Drilling

Date: 1st Qtr
Number: 7210
Revision: 1

4.3 Sample Handling and Storage

4.3.1 Upon removal of the core barrel from the drill hole, the split inner tube shall be removed and opened and, if necessary to facilitate accurate logging, the core shall be washed while it rests in the liner half. Care shall be used in washing to avoid removing small pieces of core or soft joint or vein fillings. If the rock is soft, friable, or otherwise erodible and, in the opinion of the inspecting geologist, washing will damage the core, the washing process shall be omitted.

4.3.2 The core shall be placed in wooden boxes specially constructed to hold and store rock cores. The core shall be placed in the core box with the top of the run at the upper left corner and the remaining core placed sequentially from left to right and from the rear (nearest the cover hinge) of the box to the front.

4.3.3 Wooden blocks marked with the appropriate depth and run number shall be placed between each separate core run. In addition, wherever core is lost due to the presence of a cavity or large joint (open or filled), a spacer shall be placed in the proper relative position in the core box. The spacer shall be the same length as that of the lost core and the depth range shall be marked on the spacer along with the reason for the missing core (e.g., cavity, large joint, etc.).

4.3.4 The core box shall be marked on the top and two ends with the client's name, site identification, boring number, depth range, and box number. The RQD shall be indicated on all core boxes.

5.0 Documentation

5.1 The inspecting geologist shall prepare a field boring log of each boring. The boring log shall be kept current. In addition to the data entries noted, the inspecting geologist should be careful to observe and note any of the following:

- Information on any blocking or grinding of the core during the run
- Changes in color or flow rate of the return water;

STANDARD OPERATING PROCEDURE

Title: Rock-Core Drilling

Page of 2

Date: 1st Qtr
Number: 7210
Revision: 1

being drilled. This will involve careful attention to the rates of feed and rotation and the rate of flow of drilling fluid. These rates shall be adjusted as necessary to maximize recovery. Types of bits shall also be carefully selected as to diamond size, matrix and the configuration of the bit face and water ports, so as to produce the maximum recovery for each type of rock. The inspecting geologist may require that the type of bits be varied in each hole as different rock types are encountered. In no case shall worn or damaged bits be used. Core lifters shall be checked and replaced as soon as excessive wear is evident.

4.2.2 The inspecting geologist shall make an independent determination of depth measurements and check his determinations with those made by the drilling foreman. Any discrepancy shall be resolved in the field as soon as it is discovered. All depth measurements shall be made in feet and tenths of feet.

4.2.3 Every effort should be made to use clear water as a drilling fluid. In the event that this is impractical, recirculated water may be used at the discretion of the inspecting geologist, providing a settling tank and filtering system is provided. If drilling mud is used to advance the boring through the overburden, the hole shall be washed free of all mud prior to the commencement of rock drilling.

4.2.4 To minimize core losses in soft, erodable rock, the following measures shall be required by the inspecting geologist:

- Drilling shall be restricted to short runs of 2 to 3 feet
- Drilling water pressure shall be kept low (under 150 psi)
- Feed pressure shall be kept under 100 psi.

4.2.5 Split-spoon drive samples may be taken in any zones where it is not possible to drill and obtain satisfactory recovery of soft erodable rocks. Satisfactory recovery for this purpose is defined as 50% or greater.

4.2.6 The inspecting geologist shall not permit a full coring run to be drilled if he suspects core was left in the hole on the previous run. If this is believed to have occurred, he shall direct that the next coring run be shortened by the length of core believed to have been left in the hole. This is necessary to prevent blocking the core barrel and grinding of the core.

STANDARD OPERATING PROCEDURE

Title: Rock-Core Drilling

Page of 4

Date: 1st Qtr
Number: 7210
Revision: 1

- Any unusual action of the drill rods, sudden chattering of the core barrel, rapid drop of the drill rods, etc.

Other information to include on the boring log shall be:

- Elevation of bottom of casing when seated on bedrock.
- Type of core drill, including size of core.
- Length of core recovered for each length drilled, with resulting percentage of recovery.
- Elevation at which rock was encountered.
- Elevation of each change in type of bedrock.
- Elevation of any depth of drilling at which drill water is lost in making borings.
- Time required to drill each foot.

002021

5.2 The bedrock shall be described in accordance with the procedures outlined in the SOP 7211 (Logging of Rock Cores) and will include:

1. Type: Granite, slate, shale, limestone, gneiss, sandstone, etc.
2. Condition: Broken, fissured, laminated, jointed, massive, etc.
3. Hardness: Soft, hard, medium hard, very hard, etc.

5.3 The inspecting geologist shall identify the borehole by marking the identification number of the borehole on the casing.

5.4 All documentation shall remain in the project files for an indefinite period of time following completion of the project.

STANDARD OPERATING PROCEDURE

Page of
5

Title: Rock-Core Drilling

Date:
Number: 1st Qt:
Revision: 7210
1

ROCK CORE SAMPLE LOG

PROJECT NO. _____ PROJECT NAME _____

DATE _____

SITE LOCATION/BORING NO. _____

MONITORING WELL INSTALLED (Y, N) _____ BORING LOG (Y, N) _____

TOTAL DEPTH _____

LENGTH OF CORE _____

RECOVERY % _____

CORE BOX NO. _____

002022

EQUIPMENT USED _____

COLLECTOR'S NAME _____

TOTAL TIME _____ HRS.

ROCK DESCRIPTION: TYPE/NAME _____

COLOR _____

DENSITY/HARDNESS _____

STRUCTURAL/TEXTURAL FEATURES _____

COMMENTS _____

LAB DESIGNATION _____

FURTHER ANALYSIS (TYPE) _____

Project _____ Site _____ **BORING** _____ Sh 1 of _____
 Date Started _____ Completed _____ Ground Elevation _____
 Total Depth _____ Location _____ Logged by _____
 Casing I.D. _____ Contractor _____
 Remarks _____

Elev. Feet	Depth Feet	Sample				Graphic Log	ORGANIC VAPOR ppm	Sample Description	Equipment Installed
		Type & Number	Blows per 6 in.	Depth Range	Rec.				
									002023

STANDARD OPERATING PROCEDURE

Page 1 of 6

Title: Logging of Rock Cores

Date: 1st Qtr 1
Number: 7211
Revision: 1

1.0 Purpose and Applicability

This SOP describes the procedures for the logging of rock core in order to provide a written description of the rock conditions encountered in individual test borings. The basic objective of describing rock cores is to provide a concise record of important geological and physical characteristics of the rock core such as: rock type/name, lithological/structural features, any physical conditions, including alteration, and any special geological, mineralogical, or other features pertinent to interpretation of the subsurface conditions.

2.0 Responsibilities

It shall be the responsibility of the project geologist/engineer to maintain accurate records of all core samples that are collected and also any coring attempts which fail to retrieve a sample.

3.0 Supporting Materials

- Boring logs
- Hand lens for close inspection
- Marker for labelling
- Core boxes (usually provided by drilling subcontractor)
- Dilute hydrochloric acid
- Rock hammer and pen knife
- Six-foot folding rule

4.0 Logging Procedures

4.1 General Information

The following features shall be noted for all rock types:

- color, grain size, grain shape, and the mineralogy of the grains;
- attitude of bedding, cleavage or foliation planes, and the ease of splitting along such planes;
- the attitude and degree of jointing, whether open or filled, as well as evidence of shearing, crushing, or faulting;

STANDARD OPERATING PROCEDURE

Date: 1st Qtr 1
 Number: 7211
 Revision: 1

Title: Logging of Rock Cores

- the degree of alteration or weathering, hardness of the rock, and other engineering properties;
- the "RQD" (Rock Quality Designation) for NX or larger size cores.

4.2 Igneous and Metamorphic Rocks

4.2.1 A typical description of an igneous or metamorphic rock shall include:

- name or generalized group name;
- color;
- identification of the major minerals and an estimation of the amount of each mineral (percentage estimates may be used);
- textural information and textural variations including mineral orientations, grain shapes, intergrowths, description of phenocrysts, and grain-size information;
- larger structural features such as jointing, flow banding, dip of beds, contact relationships, nature of metamorphism, and any hydrothermal effects;
- any weathering or mechanical characteristics.

4.2.2 In the field, igneous rocks should be classified according to texture and mineralogy/color to arrive at a generalized group name (for example, granite, anorthosite or basalt). Field descriptions of cataclastic rocks shall include information on the nature of the cataclasis, the type of original rock, size of blocks or clasts, presence of gouge, mineralization, and the width of zone(s).

4.2.3 If a detailed petrographic examination is performed, a more detailed classification system shall be utilized.

- Igneous rocks shall be classified according to nomenclature recommended by the IUGS Subcommittee on the Systematics of Igneous Rocks (1973).

STANDARD OPERATING PROCEDURE

Page 3 of 6

Title: Logging of Rock Cores

Date: 1st Qtr 1
Number: 7211
Revision: 1

- Metamorphic rocks, with the exception of cataclastic rocks, shall be classified according to the manner outlined in Travis (1955). A mineral name should prefix a structural term (e.g., garnet-mica schist or muscovite-biotite-quartz gneiss; the prefix "meta" may be used for rocks that retain their original fabric e.g., metagabbro).
- Cataclastic rocks should be classified according to Higgins (1971).

4.3 Sedimentary Rocks

4.3.1 A typical description of a sedimentary rock shall include:

- name;
- color;
- texture of the rock, including any information on grain size(s) and identification and estimates of amounts of minerals and fossils;
- information on lithification and diagenesis, sedimentary structures, and stratigraphic relationships;
- the nature of the cementing material occupying the intergranular spaces;
- any sedimentary structures including a description of the bedding, and any features which are useful in determining geotectonic relationships;
- a description of the weathering and engineering properties.

4.3.2 Classification of sedimentary rocks, both in core and in the field, should be based upon grain size (Wentworth, 1922), color or mineralogy and hardness;

4.3.3 If detailed petrographic examination is performed, one of the more detailed classification systems should be used. The system by Folk (1974) is suggested.

5.0 Special Tests/Analyses

5.1 Numerous analytical techniques are available to assist the core logger in his examination of the rock core. These include:

STANDARD OPERATING PROCEDURE

Page of 6

Title: Logging of Rock Cores

Date: 1st Qtr 1

Number: 7211

Revision: 1

- thin section analysis;
- chemical analysis;
- radiometric age determinations;
- other special tests.

5.2 Samples to be tested or analyzed shall be selected and transmitted in accordance with required procedures.

6.0 Documentation

6.1 All descriptive data shall be noted on the final/geologic boring by the supervising geologist(s) for core logging.

6.2 All final boring logs shall be reviewed by the site or regional geologist to assure completeness and technical accuracy.

6.2.1 Any changes, additions, or deletions to the logs shall be made so that the original entry (words and/or numbers) is still legible. Under no circumstances will any erasures be allowed. If extensive deletions and additions are necessary, then a second boring log form may be attached to the original and labelled with the original sheet number and a small "a" after said number.

6.2.2 Upon completion of this review, the site or regional geologist shall initial and date the "Checked by" section of the boring log.

6.3 All documentation shall remain in the project files for an indefinite period of time following completion of the project.

ROCK CORE SAMPLE LOG

PROJECT NO. _____ PROJECT NAME _____
DATE _____
SITE LOCATION/BORING NO. _____
MONITORING WELL INSTALLED (Y, N) _____ BORING LOG (Y, N) _____

TOTAL DEPTH _____
LENGTH OF CORE _____
RECOVERY % _____
CORE BOX NO. _____

EQUIPMENT USED _____
COLLECTOR'S NAME _____

TOTAL TIME _____ HRS.

ROCK DESCRIPTION: TYPE/NAME _____
COLOR _____
DENSITY/HARDNESS _____

STRUCTURAL/TEXTURAL FEATURES _____

COMMENTS _____

LAB DESIGNATION _____
FURTHER ANALYSIS (TYPE) _____

Project _____ Site _____ **BORING** _____ Sh 1 of _____
 Date Started _____ Completed _____ Ground Elevation _____
 Total Depth _____ Location _____ Logged by _____
 Casing I.D. _____ Contractor _____
 Remarks _____

Elev. Feet	Depth Feet	Sample				Graphic Log	ORGANIC VAPOR ppm	Sample Description	Equipment Installed
		Type & Number	Blows per 6 in.	Depth Range	Rec.				
									002029

002030

APPENDIX VIII
SOP 7130 GROUND-WATER SAMPLE COLLECTION
FROM MONITORING WELLS

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of

Date: 1 15
Number: 1st Qtr 198
Revision: 7130
0

1.0 Applicability

This Standard Operating Procedure (SOP) is concerned with the collection of valid and representative samples from ground-water monitoring wells. The scope of this document is limited to field operations and protocols applicable during ground-water sample collection.

2.0 Responsibilities

The site coordinator or his delegate will have the responsibility to oversee and ensure that all ground-water sampling is performed in accordance with the project-specific sampling program and this SOP. In addition, the site coordinator must ensure that all field workers are fully apprised of this SOP. The field team is responsible for proper sample handling as specified in SOP 7510, Handling and Storage of Samples.

3.0 Supporting Materials

The list below identifies the types of equipment which may be used for a range of ground water-sampling applications. From this list, a project-specific equipment list will be selected based upon project objectives, the depth to ground-water, purge volumes, analytical parameters and well construction. The types of sampling equipment are as follows:

- Purging/Sample Collection
 - Bailers
 - Centrifugal Pump
 - Submersible Pump
 - Peristaltic Pump
- Sample Preparation/Field Measurement
 - pH Meter
 - Specific Conductance Meter
 - Filtration Apparatus
 - Water-Level Measurement Equipment

Additional equipment to support sample collection and provide baseline worker safety will be required to some extent for each sampling task. The additional materials are separated into two primary groups: general equipment which is reusable for several samplings, and materials which are expendable.

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page 2 of 15
Date: 1st Qtr 1
Number: 7130
Revision: 0

- General

- Project-specific sampling program
- Goggles or equivalent eye protection
- Full- or half-mask respirators
- Deionized-water dispenser bottle
- Methanol-dispenser bottle

- Field data sheets and/or log book
- Preservation solutions
- Sample containers
- Buckets and intermediate containers
- Coolers
- First-Aid kit

- Expendable Materials

- Bailer Cord
- Respirator Cartridges
- Gloves
- Water Filters
- Chemical-free paper towels
- Plastic sheets

4.0 Water-Level Measurement

4.1 Introduction

After unlocking and/or opening a monitoring well, the first task will be to obtain a water-level measurement. Water-level measurements will be made using an electronic or mechanical device. Electronic measurement devices will be used in all wells wherein a clearly audible sound cannot be produced with a mechanical device.

002032

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page 3 of 15
Date: 1st Qtr 19
Number: 7130
Revision: 0

4.2 Well Security

Unlock and/or open the monitoring well. Enter a description of condition of the security system and protective casing on the Ground-Water Sample Collection Record shown in Table 1.

4.3 Measuring Point

Establish the measuring point for the well. The measuring point location should be clearly marked on the outermost casing or identified in previous sample collection records. If no measuring point can be determined, a measuring point should be established. The measuring point should be a point which is, or can easily be transposed vertically to, the survey control point for the well. Typically the top of the protective or outermost well casing will be used as the measuring point. The measuring point location should be described on the Ground-Water Sample Collection Record.

4.4. Measurement

To obtain a water-level measurement lower a decontaminated mechanical or an electronic sounding unit into the monitoring well. Care must be taken to assure that the water-level measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. The water-level measuring tape will be lowered into the well until the audible sound of the unit is detected or the light on an electronic sounder illuminates. At this time the precise measurement should be determined by repeatedly raising and lowering the tape to converge on the exact measurement. The water-level measurement should be entered on the Ground-Water Sample Collection Record.

4.5 Decontamination

The measurement device shall be decontaminated immediately after use. Two persons are usually required to perform decontamination. Two handfuls of chemical-free paper towels will be obtained and one of which will be soaked with methanol. As the tape or line is rolled back onto the reel by one person, the second will wipe all free liquids and moisture from the tape or line with one towel closest to the reel, and follow with a second wipe of methanol a few inches behind.

5.0 Purge-Volume Computation

All monitoring wells to be purged prior to sample collection. Depending upon the ease of purging, 4 to 10 volumes of ground water present in a well shall be withdrawn prior to sample collection. The

STANDARD OPERATING PROCEDURE

Ground-Water Sample Collection from Monitoring Wells

Title:

Page 40f 15
1st Qtr 19
Date: 7/30
Number: 0
Revision:

volume of water present in each well shall be computed using the two measurable values, length of water column and monitoring well inside diameter. The water column length shall be computed as shown in Item 2b of Table 1. The monitoring-well diameter may be obtained by direct measurement in the field or from the boring log. Figures 1(a) and 1(b) will be used to compute the well volume. The one (1) well volume shall be multiplied by the appropriate factor (i.e. 4-10) to obtain the total purge volume.

6.0 Applications of Well-Purging and Sample-Collection Methods

6.1 Introduction

Purging must be performed for all ground-water monitoring wells prior to sample collection. The following sections explain the procedures to be used to purge and collect samples from monitoring wells.

Three general methods are used for well purging. Well purging may be achieved using bailers, surface pumps, or down-well submersible pumps.

In all cases pH and/or specific conductance will be monitored during purging. Field parameter values will be entered on the Ground-Water Sample Collection Record along with the corresponding purge volume.

6.2 Bailing

In many cases bailing may be the most convenient method for well purging. The cost of bailers and their relative size allows that many be transported easily to be available for a field sampling program so that it is not necessary to decontaminate or clean bailers between sample points. The small size of bailers allows that complete cleaning be performed without extensive decontamination facilities.

Bailing prevents two potential problems with well purging. First, increased suspended solids may be present in samples as a result of the turbulence caused by raising and lowering the bailer through the water column. High solids concentrations may require that total suspended solids (TSS) and the chemical character of solids be evaluated during sample analyses. Second, bailing may not be feasible for wells which require that greater than twenty (20) gallons be removed during purging. Such bailing conditions

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of
Date: 5 11
Number: 1st Qtr
Revision: 7130
0

mandate that long periods be spent during purging and sample collection. All ground-water collected from monitoring wells for subsequent volatile organic analyses shall be collected using bailers, regardless of the purge method.

6.3 Surface Pumping

Ground-water withdrawal using pumps located at the ground surface is commonly performed with centrifugal or peristaltic pumps.

All applications of surface pumping will be governed by the depth to the ground-water surface. Peristaltic and centrifugal pumps are limited to conditions where ground water need only be raised through approximately 20-25 feet of vertical distance. The lift potential of a surface pumping system will depend upon the net positive suction head of the pump and the friction losses associated with the particular suction line.

Surface pumping can be used for many applications of well purging and ground-water sample collection. In all cases, pumping cannot be used for the collection of samples to be analyzed for volatile organic compounds.

6.3.1 Peristaltic Pump

Peristaltic pumps provide a low rate of flow typically in the range of 0.02-0.2 gallons/min (75-750 ml/min). For this reason, peristaltic pumps are not particularly effective for well purging. Peristaltic pumps are suitable for purging situations where a relatively long time is available for purging. Peristaltic pumps will lift water a maximum of approximately 20 - 25 feet. Peristaltic pumps are most often used for the field filtering of samples and therefore they are most often used to obtain water samples from purged monitoring wells for direct filtration.

6.3.2 Centrifugal Pump

Centrifugal pumps are designed to provide a high rate of pumping, in the range of 10-40 gallons per minute (gpm). Centrifugal pumps can be used to pump at lower rates (1-5 gpm) if friction losses in the suction line are large, the pump drive motor is maintained at low speeds, or a valve is used to regulate discharge.

When centrifugal pumps are used, samples will be obtained from the suction line during pumping by an entrapment scheme as shown in Figure 2. While pumping is ongoing the

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page 6 of 11
Date: 1st Qtr
Number: 7136
Revision: 0

containment valves will be closed and immediately thereafter the pump will be shut-off. The breather plug will then be opened and the sample obtained from the stopcock. This method will not be used for the collection of samples for analyses of volatile organic compounds.

Two methods, direct connection or down well suction line may be used for well purging and/or sample collection by centrifugal pumps.

Table 2 provides a summary of the advantages, disadvantages and applications for each of the two methods.

6.3.2.1 Direct Connection

The Direct Connection method is used to collect ground-water samples with centrifugal pumps. As with all pumping methods sample turbulence precludes the use of pumping for the collection of samples for analyses of volatile organic compounds.

Direct Connection requires that a suction line system be constructed which will allow that sample collection be performed on the suction side of the pump so that sample contamination due to pump contact is eliminated. In addition, the valve system on the suction line will provide a mechanism for the control of pumping. Each time pumping stops a valve will be closed immediately to prevent the return of water to the well which has contacted the pump.

6.3.2.2 Down-Well Suction Line

Down-well suction lines are used where direct connection cannot be made to the well riser pipe. Down-well suction lines are used for applications when purging should include raising and lowering the suction tubing throughout the entire length of the water column.

The down-well suction line method basically requires that a continuous length of tubing be used from the pump to the end of suction line. For this reason, the method is only used for well purging because samples can only be collected from the discharge side of the pump.

002036

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of

Date: 7 15
Number: 1st Qtr 1
Revision: 7130
0

6.3.3 Submersible Pump

Submersible pumps provide an effective means for well purging and in some cases sample collection. Submersible pumps are particularly useful for situations where the depth to water table is greater than twenty (20-30) feet and the depth or diameter of the well requires that a large purge volume be removed during purging. Submersible pumps also provide a continuous discharge which allows that less variability be encountered with samples collected by this method.

The Johnson-Keck pump model SP-81 which has a 1.75 inch diameter pump unit. The pump diameter restricts use to monitoring wells which have inside diameters equal to or greater than two (2) inches. As with other pump-type purge/sample collection methods, submersible pumps will not be used for the collection of samples for analyses of volatile organic compounds.

7.0 Purging- and Sample-Collection Procedures

7.1 Bailing

- 7.1.1 Obtain a clean/decontaminated bailer and a spool of polypropylene rope or equivalent bailer cord. Using the rope at the end of the spool tie a bowline knot or equivalent through the bailer loop. Test the knot for adequacy by creating tension between the line and the bailer. Tie again if needed.
- 7.1.2 Remove the aluminum foil wrapping from the bailer, and, while holding the bailer, place it inside the well to verify that an adequate annulus is present between the bailer and the well casing to allow free movement of the bailer.
- 7.1.3 Lower the bailer to the bottom of the monitoring well and remove an additional five feet of cord from the spool. Cut the cord at the spool and secure the rope to the well head or the wrist of the person who shall perform the bailing.
- 7.1.4 Raise the bailer by grasping a section of cord using each hand alternately. This bailer lift method will provide that all of the bailer cord will not come into contact with the ground or other potentially contaminated surfaces.

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of
8 1
Date: 1st Qtr
Number: 713
Revision: 0

- 7.1.5 Bailed ground water will be poured from bailer into a graduated bucket to measure the purged water volume.
- 7.1.6 During sample collection bailers will be lowered to the bottom of monitoring wells and withdrawn slowly through the entire water column.
- 7.1.7 Samples collected by bailing will be poured directly into sample containers from bailers which are full of fresh ground water. During sample collection, bailers will not be allowed to contact the sample containers.

7.2 Peristaltic Pump

- 7.2.1 Place a new suction and discharge line in the peristaltic pump. Silicon tubing must be used through the pump head. A second type of tubing may be attached to the silicon tubing to create the suction and discharge lines. Such connection is advantageous for the purpose of reducing tubing costs, but only be done if airtight connections can be made. Tygon tubing will not be used when performing well purging or collecting samples for organic analysis. The suction line must be long enough to extend to the static ground-water surface and reach further should drawdown occur during pumping.
- 7.2.2 Measure the length of the suction line and lower it down the monitoring well until the end is in the upper 2-5 inches of the water column present in the well. Start the pump and direct the discharge into a graduated bucket.
- 7.2.3 Measure the pumping rate in gallons per minute by recording the time required to fill a selected volume of a bucket. Flow measurement shall be performed three times to obtain an average rate.
- 7.2.4 The pumping shall be monitored to assure continuous discharge. If drawdown causes the discharge to stop, the suction line will be lowered very slowly further down into the well until pumping restarts. The suction line will be lowered to assure that the end of the suction line is maintained in the uppermost 2-5 inches of the water column.
- 7.2.5 Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record.

002038

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of
Date: 9 15
Number: 1st Qtr 1
Revision: 7130
 0

7.2.6 Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and Specific Conductance) have stabilized.

7.2.7 When the sample bottles are prepared, each shall be filled directly from the discharge line of the peristaltic pump. Care will be taken to keep the pump discharge line from contacting the sample bottles. Ground-water samples requiring filtration prior to placement in sample containers, will be placed in intermediate containers for subsequent filtration or filtered directly using the peristaltic pump.

7.2.8 At each monitoring point when use of the peristaltic pump is complete, all tubing including the suction line, pump head and discharge line must be disposed of. In some cases where sampling will be performed frequently at the same point, the peristaltic pump tubing may be retained between each use in a clean zip-lock plastic bag.

7.3 Centrifugal Pump

7.3.1 Direct Connection Method

7.3.1.1 Establish direct connection to the monitoring well using pipe connections, extensions, and elbows, with Teflon® tape wrapping on all threaded connections. If the centrifugal pump will subsequently be used for sample collection, a sample isolation chamber will be placed in the suction line configuration as shown in Figure 2.

7.3.1.2 Prime the pump by adding tap water to the pump housing until the housing begins to overflow.

7.3.1.3 Start the pump and direct the discharge into a graduated bucket or a bucket of known capacity (>2.5 gallons).

7.3.1.4 Measure the pumping rate in gallons per minute by recording the time required to fill a selected volume of a bucket. Flow measurement should be performed three times to obtain an average rate. Pumping will be observed at all times to determine if pumping rates are continuous, fluctuating, or diminishing. If discharge stops, the pump will be throttled back to determine if pumping will restart at a lower rate. If pumping does not

002039

STANDARD OPERATING PROCEDURE

Tide: Ground-Water Sample Collection from Monitoring Wells

Page of
Date: 10 1
Number: 1st Qtr 1
Revision: 7130
0

restart, the pump should be shut off to allow the well to recharge.

- 7.3.1.5 Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record.
- 7.3.1.6 Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and Specific Conductance) have stabilized.
- 7.3.1.7 While pumping is on-going the containment valves in the Sample Isolation Chamber will be closed and the pump immediately shut off.
- 7.3.1.8 When the sample bottle is prepared, the breather plug will be removed and the stopcock at the sample collection point opened and the sample bottle filled.
- 7.3.1.9 At each monitoring well when use of a centrifugal pump is complete, all suction line parts will be decontaminated in accordance with the SOP for Decontamination.

7.3.2 Down-Well Suction-Line Method

- 7.3.2.1 Lower a new suction line into the well. The suction line will have a total length at least great enough to extend to the water table and account for a minimum of five (5) feet of drawdown. Note should be made that drawdown may exceed the depth where pumping will terminate as a result of a limitation derived from suction-line conditions and the lift potential of the pump. All connections will be made using Teflon® ferrules and Teflon® thread wrapping tape.
- 7.3.2.2 Prime the pump by adding tap water to the pump housing until the housing begins to overflow.
- 7.3.2.3 Start the pump and direct the discharge into a graduated bucket or a bucket of known capacity (>2.5 gallons).
- 7.3.2.4 Measure the pumping rate in gallons per minute by recording the time required to fill a selected

002040

STANDARD OPERATING PROCEDURE

Page of

Title:

Ground-Water Sample Collection from Monitoring Wells

Date: 11
Number: 1st Qtr
Revision: 7130

volume of a bucket. Flow measurement should be performed three times to obtain an average rate. Pumping will be observed at all times to determine if pumping rates are continuous, fluctuating or diminishing. If discharge stops, the pump will be throttled back to determine if pumping will restart at a lower rate. If pumping does not restart, the pump should be shut off to allow the well to recharge.

The rate of recharge will be measured by inserting water-level measurement equipment down the well to determine approximately at what rate the well is recharging, and therefore when pumping may be restarted. All information pertaining to discharge conditions and recharge rates will be entered on the Ground-Water Sample Collection Record.

7.3.2.5 Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record.

7.3.2.6 The valve at the pump on the line will be closed whenever pumping terminates or pumping is stopped. This practice will minimize the return to the well of water which has contacted the inside of the pump housing.

7.3.2.8 At each monitoring well when use of a centrifugal pump is complete all suction line tubing will be disposed of.

7.4 Submersible Pump

7.4.1 Prior to using a submersible pump, a check will be made of well diameter and alignment. A 1.75 inch diameter decontaminated cylindrical tube will be lowered to the bottom of each monitoring well to determine if the alignment or plumbness of a well is adequate to accommodate the submersible pump. The well alignment survey may also be used to determine the total depths of wells. All observations will be entered in the Ground-Water Sample Collection Record.

7.4.2 Slowly lower the submersible pump into the monitoring well taking notice of any roughness or restrictions within the riser.

STANDARD OPERATING PROCEDURE

Page of

Title:

Ground-Water Sample Collection from Monitoring Wells

Date: 12 1
Number: 1st Qtr
Revision: 7130

- 7.4.3 Count the graduations on the pump discharge line and stop lowering when the stainless steel portion is below the uppermost section of the static water column within monitoring well. Secure the discharge line and power cord to the well casing.
- 7.4.4 Connect the power cord to the power source (i.e., rechargeable battery pack or auto battery monitor) and turn the pump on (forward mode). When running, the pump can usually be heard by listening near the well head.
- 7.4.5 Voltage and amperage meter readings on the pump discharge will be checked continuously. The voltage reading will decline slowly during the course of a field day representing the use of power from the battery. Amperage readings will vary depending upon the depth to water table. Amperage readings greater than 10 amps usually indicate a high solids content in the ground water in which cases pump clogging will most likely occur. If a steady increase in amperage is observed, the pump should be shut off, allowed to stop, switched to the reverse mode, stopped again and then placed in forward mode. If high amperage readings persist, the pump should be withdrawn and checked using the large upright cylinder and tap water. Ground-water conditions such as high solids may require that an alternate purge/sample method be used.
- 7.4.6 Drawdown will be monitored continuously by remaining near the well at all times and listening to the pump. When drawdown occurs, a metallic rotary sound will be heard as the pump intake becomes exposed and ceases to discharge water, but continues to run. The pump will be lowered immediately to continue pumping water within the uppermost section of the static water column. NOTE: The submersible pump will not be allowed to run while not pumping for more than five seconds.
- If drawdown continues to the extent that the well is pumped dry, the well will be allowed to recharge. The rate of recharge will be approximately determined by re-starting the submersible pump after a ten (10) minute period with the pump off. The pumping rate shall be re-measured and/or the total discharge volume collected to determine the recharge volume.
- 7.4.7 Direct the pump discharge to a graduated bucket or a bucket of known capacity.

002042

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of
Date: 13 1
1st Qtr 1
Number: 7130
Revision: 0

- 7.4.8 Measure the pumping rate in gallons per minute by recording the time required to fill a selected volume of a bucket. Flow measurement shall be performed three times to obtain an average rate. The performance of a submersible pump will be observed at all times by at least one field worker.
- 7.4.9 Measurements of pH and specific conductance will be made periodically during well purging. All readings and respective purge volumes will be entered on the Ground-Water Sample Collection Record.
- 7.4.10 Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and specific conductance) have stabilized.
- 7.4.11 While pumping is on-going and when sample bottles are prepared, bottles will be filled directly from the discharge line of the pump taking care not to touch sample bottles to the discharge line.
- 7.4.12 At each monitoring well when use of the submersible pump is complete, the pump, discharge line and power cord shall be decontaminated according to the procedures contained in the SOP for Decontamination.

002043

8.0 Sample Preparation

Prior to transport or shipment, ground-water samples may require preparation and/or preservation. Field preparation may entail filtration, or preservation in the form of chemical additives or temperature control.

Specific preservation techniques are described in the EPA document, Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA-600/4-82-029). The EPA manual will be consulted during the planning stage of the project. Project-specific sampling plans shall be assembled using the approved procedures obtained from the EPA manual.

STANDARD OPERATING PROCEDURE

Title:

Ground-Water Sample Collection from Monitoring Wells

Page of

Date: 14

Number: 1st Qt

Revision: 713C

9.0 Documentation

A number of different documents will be completed and maintained as a part of ground-water sampling. The documents will provide a summary of the sample-collection procedures and conditions, shipment method, the analyses requested and the custody history. The list of documents is:

- Ground-water sample collection record
- Sample labels
- Chain-of-custody
- Shipping receipts

Sample labels shall be completed at the time each sample is collected and will include the information listed below. A sample label is shown in Figure 3.

- Client or project name
- Sample number
- Designation (i.e., identification of sample point no.)
- Analysis
- Preservative (e.g., filtration, acidified pH<2 HNO₃)
- Sample-collection date
- Sampler's name

Figure 4 displays the chain of custody record used. The chain of custody form is the record sample collection and transfer of custody. Information such as the sample collection date, sample identification and origination, client or project name shall be entered on each chain of custody record. In accordance with 40 CFR 261.4(d) the following information must accompany all ground water samples which are known to be non-hazardous and to which U.S. Department of Transportation and U.S. Post Office regulations do not apply. Such information is:

- sample collector's name, mailing address and telephone number,
- analytical laboratory's name, mailing address and telephone number,
- quantity of each sample,
- date of shipment, and
- description of sample

002044

STANDARD OPERATING PROCEDURE

Title: Ground-Water Sample Collection from Monitoring Wells

Page of

Date: 15
Number: 1st Qtr
Revision: 7130

The chain of custody forms provide a location for entry of the above-listed information.

10.0 References

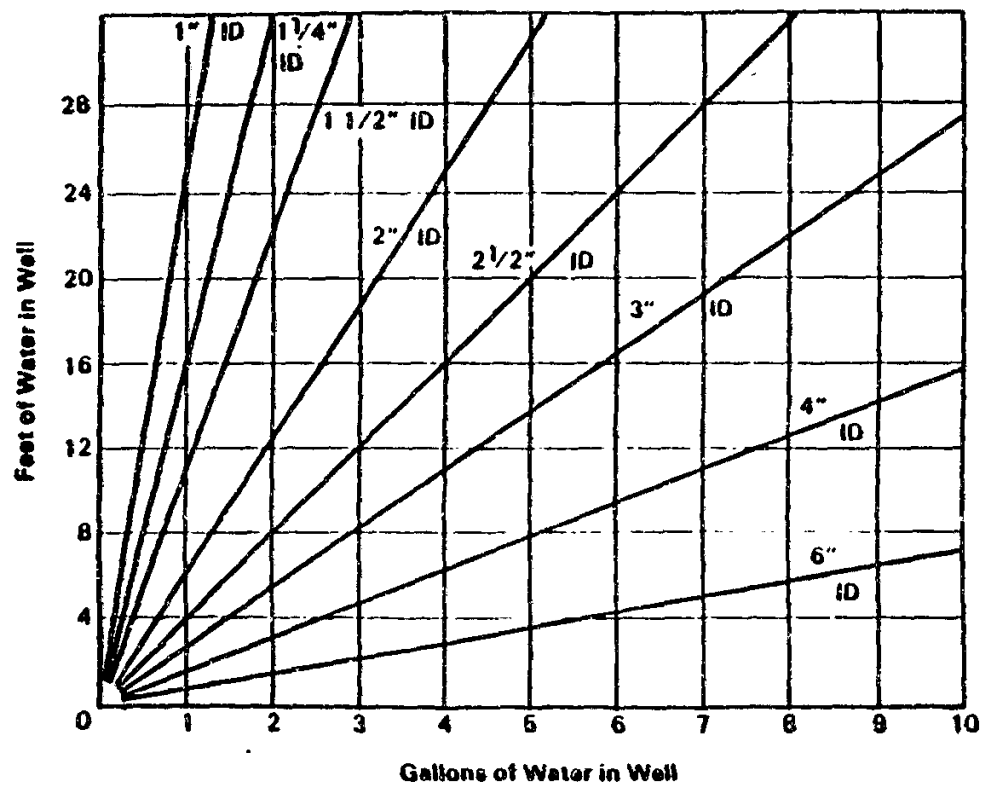
EPA. Handbook for Sampling and Sample Preservation of Water and Wastewater EPA-600/4-82-029, September 1982.

Geotrans, Inc. RCRA Permit Writer's Manual, Ground-Water Protection prepared for U.S. EPA. Contract No. 68-01-6464, October 1983.

Code of Federal Regulations, Chapter 40 (Section 261.4(d)).

002045

91-111A



(a) Graphical Explanation

Volume/Linear Ft. of Pipe		
ID(in)	Gal	Liter
1/4	0.003	0.010
3/8	0.006	0.022
1/2	0.010	0.039
3/4	0.023	0.087
1	0.041	0.154
2	0.163	0.618
3	0.367	1.39
4	0.653	2.47
6	1.47	5.56

(b) Volume Factors

Figure 1 - Purge Volume Computation

002046

VIII-17

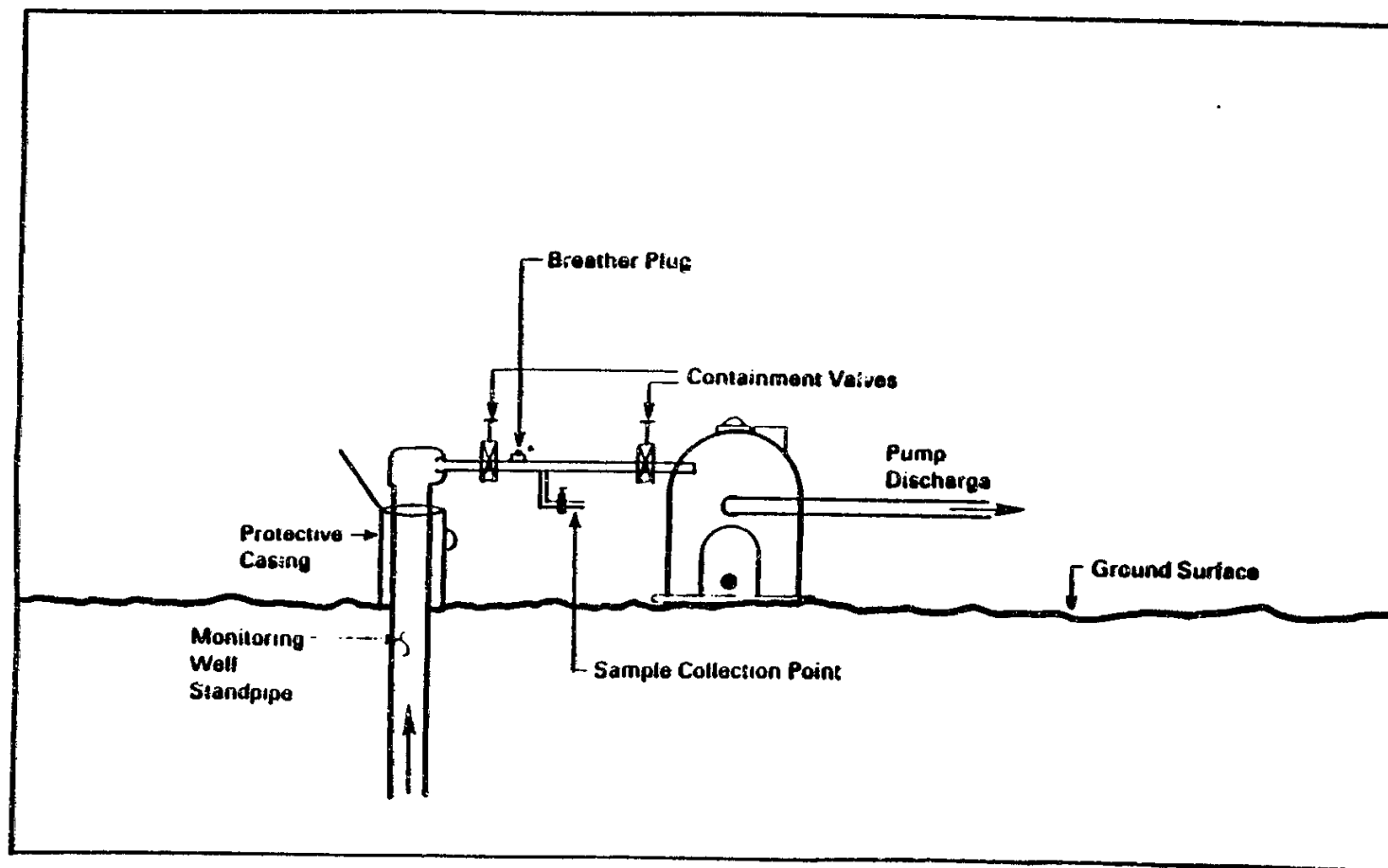


Figure 2 Down Well Suction Line Configuration

002047

Project
Name _____
SAMPLE NO. _____
DESIGNATION _____
ANALYSIS _____
PRESERVATIVE _____
DATE _____ BY _____

Figure 3 Sample Container Label

002048

APPENDIX IX
SOP 7220 MONITORING-WELL
CONSTRUCTION AND INSTALLATION

002049

STANDARD OPERATING PROCEDURE

Page 2 of 4

Title: Monitoring-Well Construction and Installation

Date: 1st Qtr 1

Number: 7220

Revision: 1

1.0 Purpose and Applicability

This SOP establishes the method for installing observation standpipes, or monitoring wells. These wells will be installed to: determine the depth to ground water, monitor ground-water fluctuations and obtain samples of ground water for laboratory testing.

2.0 Responsibilities

It is the responsibility of the project geologist/engineer to directly supervise the construction and installation of each monitoring well by the contract driller to ensure that the well-installation specifications are adhered to and to record all pertinent data on the approved forms.

3.0 Supporting Materials

The monitoring well shall consist of a commercially available well screen constructed of brass, stainless steel or slotted PVC plastic pipe of minimum 2-inch nominal ID (inside diameter). The length of the screened area and the gage of the screen or slots shall be determined by the inspecting geologist depending upon the grain-size distribution of the soils. Blank plastic, black, galvanized or stainless steel pipe of minimum 2-inch ID shall be used to complete the standpipe approximately 2 feet above the existing grade. The riser pipe shall be connected by flush, threaded joints. No solvent or anti-sieze compound shall be used on the joints.

The section of riser pipe that sticks up above ground shall be protected by 3 or 4-inch diameter steel guard pipe, up to 5 feet long set 2 feet into the concrete surface seal. The top of the guard pipe shall have a vented lockable cap.

Other materials used for well construction include silica sand, bentonite, cement, and a calibrated tape for length measurements and water-level measurements. Construction materials are generally provided by the drilling subcontractor.

4.0 Procedure for Construction

4.1 After drilling and soil sampling has been completed, the casing shall be flushed free of cuttings to develop a clean, uniform hole. Flushing shall be continued until the return water is clear.

4.2 Grouting of the borehole to the well-screen tip elevation shall be required if the tip is to be above the bottom of the borehole. A heavy plumb bob and a calibrated tape shall be used to determine the depth of the boring and the depth to the top of the grout plug.

STANDARD OPERATING PROCEDURE

Page 2 of 4

Title: Monitoring-Well Construction and Installation

Date:
Number: 1st Qtr
Revision: 7220
1

- 4.3 The well screen and riser pipe shall then be assembled. The assembled screen and riser or its constituent parts shall be decontaminated as described in SOP 7400, Decontamination.
 - 4.4 The rise and screen shall be carefully placed in the borehole to ensure that it is centered in the hole.
 - 4.5 The annular space surrounding the screened section of the monitoring well and at least two feet above the top of the screen shall be filled with uniform, fine sand.
 - 4.6 It may be necessary to seal off the well screen by placing a grout seal on top of the sand at a specified depth. The project geologist/engineer or shall give detailed instructions if sealing off of the well screen is required. This grouting may consist of a bentonite seal of approximately 2 feet in thickness to prevent vertical flow within the boring from affecting the screened area.
 - 4.7 The remaining length of borehole shall be backfilled with sand or grout to within 2 feet of the ground surface. This grouting may consist of a bentonite/cement mixture made to required specification.
 - 4.8 The 3- or 4-inch diameter steel guard-pipe shall be placed around the riser, and the borehole around the guard pipe shall be dug out to approximately a 1-foot radius to a depth of 2 feet, and filled with concrete. All completed wells will have identification numbers clearly painted on the cap and guard pipe with bright colored paint.
- 5.0 Documentation Procedures
- 5.1 During installation of each monitoring well a series of measurements shall be taken and documented. These measurements shall include:
 - length of screen
 - length of riser pipe
 - total length of well
 - depth to stabilized water level

STANDARD OPERATING PROCEDURE

Title: **Monitoring-Well Construction and Installation**

Page of 4
3
Date: 1st Qtr 1
Number: 7220
Revision: 1

Other data include type and length of casing, diameters of the respective components, thicknesses and different types of grouting materials, and elevation of the top of the guard pipe and ground surface after surveying is complete.

- 5.2 All data shall be recorded on site onto the ground-water monitoring well installation report and all wells shall be referenced onto the appropriate site map. A field book and/or boring log can be used as other means of recording data. All documentation shall remain in the project files indefinitely.

002052

GROUND WATER STANDPIPE INSTALLATION REPORT

STANDPIPE No. _____
BORING No. _____
SH. _____ C. _____

PROJECT _____ SITE _____ DATE: START _____ FINISH _____
LOCATION _____ GROUND ELEV. _____ TOTAL DEPTH (FT.) _____
CONTRACTOR _____ LOGGED BY _____ CHK'D BY _____

LOG OF MATERIALS	SURVEY DATUM _____	ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF CASING OR ROAD-WAY BOX _____
	GROUND ELEVATION _____	ELEVATION OR STICKUP ABOVE/BELOW GROUND SURFACE OF RISER PIPE _____
	BENTONITE/CEMENT _____	THICKNESS OF SURFACE SEAL _____
		TYPE OF SURFACE SEAL _____
		[INDICATE ALL SEALS SHOWING DEPTH, THICKNESS AND TYPE] _____
		TYPE OF CASING _____
		INSIDE DIAMETER OF CASING _____
		ELEVATION/DEPTH OF BOTTOM OF CASING _____
		INSIDE DIAMETER OF RISER PIPE _____
		TYPE OF BACKFILL AROUND RISER _____
		DIAMETER OF BOREHOLE _____
		ELEVATION/DEPTH OF BOTTOM OF RISER _____
		TYPE OF POINT OR MANUFACTURER _____
		SCREEN GAUGE OR SIZE OF OPENINGS _____
		DIAMETER OF WELLPOINT _____
	TYPE OF BACKFILL AROUND POINT _____	
	ELEVATION/DEPTH OF BOTTOM OF POINT _____	
	ELEVATION/DEPTH OF BOTTOM OF BOREHOLE _____	

002053

L3

L1

L2

$$\left[\text{LENGTH OF CASING } L_3 \right] + \left[\text{LENGTH OF RISER PIPE } (L_1) \right] + \left[\text{LENGTH OF POINT } (L_2) \right] = \text{TOTAL DEPTH}$$

APPENDIX X
OPERATING PROCEDURES FOR SAMPLING
OF ORGANIC VAPORS AND
AIRBORNE PARTICULATES

002054

OPERATING PROCEDURES FOR SAMPLING OF
ORGANIC VAPORS AND AIRBORNE PARTICULATES

Field Procedures

A known volume of ambient air will be drawn through a sampling train consisting of a 10 cm diameter glass fiber filter followed by a glass canister containing XAD-2 porous polymer adsorbent. Both particulate organic matter and organic vapors present will be determined by this procedure. Filters and adsorbent fractions will be analyzed separately for specific organic compounds as discussed under the Laboratory Analysis Section. After leaving the adsorbent canister, sample gas will be drawn through a silica gel drying tube, a leak free pump, and a calibrated dry gas meter. A flow rate of 0.7 cubic feet per minute (CFM) will be maintained which will result in a total sample volume of 84 cubic feet (2400 litres) for a two hour test. Assuming that the compounds in question were present at concentrations as low as the published Ambient Air Multimedia Environmental Goals, sufficient sample would be collected to meet the detection limits of the analytical procedures employed for quantification.

Approximately 40 grams of purified XD-2 adsorbent will be loaded into each 1.5" I.D. by 5" long glass canister and secured with a glass wool plug. Canister face velocity will approach 0.9 feet per second. All sorbent canisters will be preloaded and sealed in the Monroeville, Pennsylvania, laboratory and immediately re-sealed after field use for transport back to Monroeville. In addition, all canisters and filters will be refrigerated or kept on ice while in storage and in transit.

To assure complete adsorption of organics during sampling, the canister will be packed in ice. Also to help prevent possible photochemical degradation of organics adsorbed on particulate matter, and filter will be shielded from sunlight with aluminum foil.

One unused filter and adsorbent canister will be chosen at random in the field and retained as a blank for every ten air samples. These will be subjected to the same extraction and analytical procedures as the field samples.

To validate the collection efficiency of the XAD-2 adsorbent for the compounds in question, a second glass canister will be run in series for one of the three test runs at the downwind position. This canister will be extracted and submitted for analysis as a separate sample.

Laboratory Procedures

The procedures to be incorporated which will recover the collected materials will include separate soxhlet extractions of the glass fiber filter and the XAD-2 resin. Extracts will be concentrated and submitted for analysis by EPA Methods 604⁽⁴⁾ and 610⁽⁵⁾. These methods have been chosen because of the inherent accuracy of the procedures. This accuracy (detection limit) for the most part is better than GC/MS methods ⁽⁶⁾ for the same compounds. Table 2 is presented to illustrate the difference in detection limits between the GC and liquid chromatography and the GC/MS procedure. The detection limits present on Table 2 are the published limits of the referenced methods. As such, the limits are in units of micrograms per liter of water sample extracted. These detection limits are offered as a comparison only as conversion of such units to an air concentration would be difficult at this time.

002056

TABLE 1
CONTAMINANTS IDENTIFIED IN SOIL SAMPLES
FROM KOPPERS SOUTH CAVALCADE SITE

<u>Compound</u>	<u>Boiling Point, oC</u>
Acenaphthene	278
Acenaphthylene	270
Anthracene	348
Benzo(a)pyrene	311
Benzofluoranthenes	481
Chrysene	488
Fluoranthene	250
Naphthalene	217
Phenanthrene	340
Pyrene	404
2-Methylnaphthalene	241

002057

TABLE 2

DETECTION LIMITS OF
HYDROCARBON ANALYTICAL PROCEDURES

<u>Compounds</u>	<u>Detection Limits of Methods (ug/l)</u>		
	<u>Method 604</u>	<u>Method 610</u>	<u>Method 625</u>
2-Chlorophenol	0.31		3.3
2-Nitrophenol	0.45		3.6
Phenol	0.14		1.5
2,4-Dimethylphenol	0.32		2.7
2,4 Dichlorophenol	0.39		2.7
2,4,6 Trichlorophenol	0.64		2.7
4 Chloro-3-methylphenol	0.36		3.0
2,4 Dinitrophenol	13.0		42.0
2-Methyl-4,6, dinitrophenol	16.0		24.0
Pentachlorophenol	0.59 ²		3.6
4-Nitrophenol	2.8		2.4
Napthalene		1.8	1.6
Acenaphthylene		2.3	3.5
Acenaphthene		1.8	1.9
Fluorene		0.21	1.9
Phenanthrene		0.64	5.4
Anthracene		0.66	1.9
Fluoranthene		0.21	2.2
Pyrene		0.27	1.9
Benzo(a)anthracene		0.013	7.8
Chrysene		0.15	2.5
Benzo(b)fluoranthene		0.018	4.8
Benzo(k)fluoranthene		0.017	2.5
Benzo(a)pyrene		0.023	2.5
Dibenzo(a,h)anthracene		0.030	2.5
Benzo(g,h,i)perylene		0.076	4.1
Ideno(1,2,3-c,d)pyrene		0.043	3.7

1 ug/l of extracted solution

2 Derivatization procedure

002058

REFERENCES

1. Hansen, E. M., Protocol for the Collection and Analysis of Volatile POHCs Using Vost. EPA-600/8-84-007. 1984.pp.vii-viii.
2. Riggin, R. M., Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air, 1983, EPA-600 (4-83-027) pp. 37-102.
3. Reference 1 pp. B2-B5.
4. EPA Test Methods "Phenols - Method 604", July 1982, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.
5. EPA Test Method "Polynuclear Aromatic Hydrocarbons - Method 610", July 1982, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.
6. EPA Test Method "Base/Neutrals and Acids - Method 625" July 1982, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

002059

APPENDIX XI

SOP 7510 PACKAGING AND SHIPMENT OF SAMPLES

002060

Title: **STANDARD OPERATING PROCEDURE**
Packaging and Shipment of Samples

Page 1 of 6
1st Qtr. 1984
Date: SOP 7510
Number:
Revision:

1.0 Applicability

This Standard Operating Procedure (SOP) is concerned with the presentation of protocols associated with the packaging and shipment of samples. Two general categories of samples exist: environmental samples consisting of air, water and soil; and waste samples which include non-hazardous solid wastes and hazardous wastes as defined by 40 CFR Part 261.

2.0 Responsibilities

It is the responsibility of the project manager to assure that the proper packaging and shipping techniques are entered into each project specific sampling plan. The site operations manager shall be responsible for the enactment and completion of the packaging and shipping requirements outlined in project specific sampling plans. The site operations manager shall be responsible to research, identify and follow all applicable U.S. Department of Transportation (DOT) regulations.

3.0 General Method

The objective of sample packaging and shipping protocol is to identify standard procedures which will minimize the potential for sample spillage or leakage and maintain field sampling program compliance with U.S. EPA and U.S. DOT regulations.

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when all of the following conditions are applicable:

- A. Samples are being transported to a laboratory for analysis;
- B. Samples are being transported to the collector from the laboratory after analysis;
- C. Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Qualification for categories A and B above require that sample collectors comply with U.S. DOT and U.S. Postal Service (USPS) regulations or comply with the following items if U.S. DOT and USPS regulations are found not to apply:

002061

STANDARD OPERATING PROCEDURE

Title: Packaging and Shipment of Samples

Date: 1st Qtr. 1984
Number: SOP 7510
Revision:

The following information must accompany all samples and will be entered on a sample specific basis on chain of custody records:

- sample collector's name, mailing address and telephone number.
- analytical laboratory's name, mailing address and telephone number.
- quantity of sample.
- date of shipment
- description of sample

In addition, all samples must be packaged so that they do not leak, spill or vaporize.

4.0 Method

- 4.1 Place plastic bubble wrap matting over the base and bottom corners of each cooler or shipping container as needed to manifest each sample.
- 4.2 Obtain a chain of custody record as shown in Figure 1 and enter all the appropriate information as discussed in Section 3.0 of this SOP. Chain of custody records will include complete information for each sample. One or more chain of custody records shall be completed for each cooler or shipping container as needed to manifest each sample.
- 4.3 Wrap each sample bottle individually and place standing upright on the base of the appropriate cooler, taking care to leave room for some packing material and ice or equivalent. Rubber bands should be used to secure wrapping, completely around each sample bottle.
- 4.4 Place additional bubble wrap and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler.
- 4.5 Place ice or cold packs in heavy duty zip-loc type plastic bags, close the bags, and distribute such packages over the top of the samples.
- 4.6 Add additional bubble wrap/styrofoam pellets to fill the balance of the cooler or container.
- 4.7 Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain of custody form. Sign and date the chain of custody tape.

002062

STANDARD OPERATING PROCEDURE
Packaging and Shipment of Samples
Title:

- 4.8 To complete the chain of custody form enter the type of analysis required for each sample, by container, under the "ANALYSES" section. Under the specific analysis enter the quantity/volume of sample collected for each corresponding analysis.

If shipping the samples where travel by air or other public transportation is to be undertaken, sign the chain of custody record thereby relinquishing custody of the samples. Relinquishing custody should only be performed when directly transmitting custody to a receiving party or when transmitting to a shipper for subsequent receipt by the analytical laboratory. Shippers should not be asked to sign chain of custody records.

- 4.9 Remove the back carbon copy from the chain of custody record and retain with other field notes. Place the remaining copies in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container.
- 4.10 Close the top or lid of the cooler or shipping container and with another person rotate/shake the container to verify that the contents are packed so that they do not move. Improve the packaging if needed and reclose.

When travelling with samples by automobile, and where periodic changes of ice are required, the cooler should only be temporarily closed so that reopening is simple. In these cases, chain of custody will be maintained by the person transporting the sample and chain of custody tape will not be used.

- 4.11 Place the chain of custody tape at two different locations on the cooler or container lid and overlap with transparent packaging tape.
- 4.12 Packaging tape should be placed entirely around the sample shipment containers. A minimum of one to two full rotations of packaging tape will be placed at at least two places on the cooler. Shake the cooler again to verify that the sample containers are well packed.
- 4.13 If shipment is required, transport the cooler to an overnight express package terminal. Obtain copies of all shipment records as provided by the shipper.
- 4.14 If the samples are to travel as luggage, check with regular baggage.

002063

STANDARD OPERATING PROCEDURE

Title: Packaging and Shipment of Samples

Date: 1st Qtr. 1984
Number: SOP 7510
Revision:

4.15 Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and sign as "received for laboratory" each chain of custody form. The laboratory will verify that the chain of custody tape has not been broken previously and that the chain of custody tape number corresponds with the number on the chain of custody record. The analytical laboratory will then forward the back copy of the chain of custody record to the sample collector to indicate that sample transmittal is complete.

5.0 Documentation

As discussed in Section 4.0 the documentation for supporting the sample packaging and shipping will consist of chain of custody records and shipper's records. In addition a description of sample packaging procedures will be written in the field log book. All documentation will be retained in the project files following project completion.

002064

APPENDIX XII

METHOD 120.1 SPECIFIC CONDUCTANCE

METHOD 150.1 pH

METHOD 170.1 TEMPERATURE

METHOD 360.1 DISSOLVED OXYGEN

002065

CONDUCTANCE

Method 120.1 (Specific Conductance, μmhos at 25°C)

STORET NO. 00095

1. Scope and Application
 - 1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).
2. Summary of Method
 - 2.1 The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge-type, or equivalent.
 - 2.2 Samples are preferable analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C.
3. Comments
 - 3.1 Instrument must be standardized with KCl solution before daily use.
 - 3.2 Conductivity cell must be kept clean.
 - 3.3 Field measurements with comparable instruments are reliable.
 - 3.4 Temperature variations and corrections represent the largest source of potential error.
4. Sample Handling and Preservation
 - 4.1 Analyses can be performed either in the field or laboratory.
 - 4.2 If analysis is not completed within 24 hours of sample collection, sample should be filtered through a 0.45 micron filter and stored at 4°C. Filter and apparatus must be washed with high quality distilled water and pre-rinsed with sample before use.
5. Apparatus
 - 5.1 Conductivity bridge, range 1 to 1000 μmho per centimeter.
 - 5.2 Conductivity cell, cell constant 1.0 or micro dipping type cell with 1.0 constant. YSI #3405 or equivalent.
 - 5.4 Thermometer
6. Reagents
 - 6.1 Standard potassium chloride solutions, 0.01 M: Dissolve 0.7456 gm of pre-dried (2 hour at 105°C) KCl in distilled water and dilute to 1 liter at 25°C.
7. Cell Calibration
 - 7.1 The analyst should use the standard potassium chloride solution (6.1) and the table below to check the accuracy of the cell constant and conductivity bridge.

Approved for NPDES
Issued 1971.
Editorial revision, 1982

120.1-1

XII-1

Conductivity 0.01 m KCl

°C

Micromhos/cm

21	1305
22	1332
23	1359
24	1386
25	1413
26	1441
27	1468
28	1496

8. Procedure

- 8.1 Follow the direction of the manufacturer for the operation of the instrument.
- 8.2 Allow samples to come to room temperature (23 to 27°C), if possible.
- 8.3 Determine the temperature of samples within 0.5°C. If the temperature of the samples is not 25°C, make temperature correction in accordance with the instruction in Section 9 to convert reading to 25°.

9. Calculation

- 9.1 These temperature corrections are based on the standard KCl solution.
 - 9.1.1 If the temperature of the sample is below 25°C, add 2% of the reading per degree.
 - 9.1.2 If the temperature is above 25°C, subtract 2% of the reading per degree.
- 9.2 Report results as Specific Conductance, $\mu\text{mhos/cm}$ at 25°.

10. Precision and Accuracy

- 10.1 Forty-one analysts in 17 laboratories analyzed six synthetic water samples containing increments of inorganic salts, with the following results:

Increment as Specific Conductance	Precision as Standard Deviation	Bias, %	Accuracy as Bias, $\mu\text{mhos/cm}$
100	7.55	-2.02	-2.0
106	8.14	-0.76	-0.8
808	66.1	-3.63	-29.3
848	79.6	-4.54	-38.5
1640	106	-5.36	-87.9
1710	119	-5.08	-86.9

(FWPCA Method Study 1, Mineral and Physical Analyses.)

- 10.2 In a single laboratory (EMSL) using surface water samples with an average conductivity of 536 $\mu\text{mhos/cm}$ at 25°C, the standard deviation was ± 6 .

120.1-2

XII-2

002067

pH

Method 150.1 (Electrometric)

STORET NO.

Determined on site 00400

Laboratory 00403

1. Scope and Application
 - 1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).
2. Summary of Method
 - 2.1 The pH of a sample is determined electrometrically using either a glass electrode in combination with a reference potential or a combination electrode.
3. Sample Handling and Preservation
 - 3.1 Samples should be analyzed as soon as possible preferably in the field at the time of sampling.
 - 3.2 High-purity waters and waters not at equilibrium with the atmosphere are subject to changes when exposed to the atmosphere, therefore the sample containers should be filled completely and kept sealed prior to analysis.
4. Interferences
 - 4.1 The glass electrode, in general, is not subject to solution interferences from color, turbidity, colloidal matter, oxidants, reductants or high salinity.
 - 4.2 Sodium error at pH levels greater than 10 can be reduced or eliminated by using a "low sodium error" electrode.
 - 4.3 Coatings of oily material or particulate matter can impair electrode response. These coatings can usually be removed by gentle wiping or detergent washing, followed by distilled water rinsing. An additional treatment with hydrochloric acid (1 + 9) may be necessary to remove any remaining film.
 - 4.4 Temperature effects on the electrometric measurement of pH arise from two sources. The first is caused by the change in electrode output at various temperatures. This interference can be controlled with instruments having temperature compensation or by calibrating the electrode-instrument system at the temperature of the samples. The second source is the change of pH inherent in the sample at various temperatures. This error is sample dependent and cannot be controlled, it should therefore be noted by reporting both the pH and temperature at the time of analysis.
5. Apparatus
 - 5.1 pH Meter-laboratory or field model. A wide variety of instruments are commercially available with various specifications and optional equipment.

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150.1-1

- 5.2 Glass electrode.
- 5.3 Reference electrode—a calomel, silver-silver chloride or other reference electrode of constant potential may be used.
- NOTE 1: Combination electrodes incorporating both measuring and reference functions are convenient to use and are available with solid, gel type filling materials that require minimal maintenance.
- 5.4 Magnetic stirrer and Teflon-coated stirring bar.
- 5.5 Thermometer or temperature sensor for automatic compensation.
6. Reagents
- 6.1 Primary standard buffer salts are available from the National Bureau of Standards and should be used in situations where extreme accuracy is necessary.
- 6.1.1 Preparation of reference solutions from these salts require some special precautions and handling⁽¹⁾ such as low conductivity dilution water, drying ovens, and carbon dioxide free purge gas. These solutions should be replaced at least once each month.
- 6.2 Secondary standard buffers may be prepared from NBS salts or purchased as a solution from commercial vendors. Use of these commercially available solutions, that have been validated by comparison to NBS standards, are recommended for routine use.
7. Calibration
- 7.1 Because of the wide variety of pH meters and accessories, detailed operating procedures cannot be incorporated into this method. Each analyst must be acquainted with the operation of each system and familiar with all instrument functions. Special attention to care of the electrodes is recommended.
- 7.2 Each instrument/electrode system must be calibrated at a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart.
- 7.2.1 Various instrument designs may involve use of a "balance" or "standardize" dial and/or a slope adjustment as outlined in the manufacturer's instructions. Repeat adjustments on successive portions of the two buffer solutions as outlined in procedure 8.2 until readings are within 0.05 pH units of the buffer solution value.
8. Procedure
- 8.1 Standardize the meter and electrode system as outlined in Section 7.
- 8.2 Place the sample or buffer solution in a clean glass beaker using a sufficient volume to cover the sensing elements of the electrodes and to give adequate clearance for the magnetic stirring bar.
- 8.2.1 If field measurements are being made the electrodes may be immersed directly in the sample stream to an adequate depth and moved in a manner to insure sufficient sample movement across the electrode sensing element as indicated by drift free (<0.1 pH) readings.
- 8.3 If the sample temperature differs by more than 2°C from the buffer solution the measured pH values must be corrected. Instruments are equipped with automatic or manual

⁽¹⁾National Bureau of Standards Special Publication 260.

compensators that electronically adjust for temperature differences. Refer to manufacturer's instructions.

8.4 After rinsing and gently wiping the electrodes, if necessary, immerse them into the sample beaker or sample stream and stir at a constant rate to provide homogeneity and suspension of solids. Rate of stirring should minimize the air transfer rate at the air water interface of the sample. Note and record sample pH and temperature. Repeat measurement on successive volumes of sample until values differ by less than 0.1 pH units. Two or three volume changes are usually sufficient.

8.5 For acid rain samples it is most important that the magnetic stirrer is not used. Instead, swirl the sample gently for a few seconds after the introduction of the electrode(s). Allow the electrode(s) to equilibrate. The air-water interface should not be disturbed while measurement is being made. If the sample is not in equilibrium with the atmosphere, pH values will change as the dissolved gases are either absorbed or desorbed. Record sample pH and temperature.

9. Calculation

9.1 pH meters read directly in pH units. Report pH to the nearest 0.1 unit and temperature to the nearest °C.

10. Precision and Accuracy

10.1 Forty-four analysts in twenty laboratories analyzed six synthetic water samples containing exact increments of hydrogen-hydroxyl ions, with the following results:

pH Units	Standard Deviation pH Units	Accuracy as	
		Bias, %	Bias, pH Units
3.5	0.10	-0.29	-0.01
3.5	0.11	-0.00	
7.1	0.20	+1.01	+0.07
7.2	0.18	-0.03	-0.002
8.0	0.13	-0.12	-0.01
8.0	0.12	+0.16	+0.01

(FWPCA Method Study 1, Mineral and Physical Analyses)

10.2 In a single laboratory (EMSL), using surface water samples at an average pH of 7.7, the standard deviation was ± 0.1 .

Bibliography

1. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 460, (1975).
2. Annual Book of ASTM Standards, Part 31, "Water", Standard D1293-65, p 178 (1976).
3. Peden, M. E. and Skowron, L. M., Ionic Stability of Precipitation Samples, Atmospheric Environment, Vol. 12, pp. 2343-2349, 1978.

TEMPERATURE

Method 170.1 (Thermometric)

STORET NO. 00010

1. Scope and Application
 - 1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.
2. Summary of Method
 - 2.1 Temperature measurements may be made with any good grade of mercury-filled or dial type centigrade thermometer, or a thermistor.
3. Comments
 - 3.1 Measurement device should be routinely checked against a precision thermometer certified by the National Bureau of Standards.
4. Precision and Accuracy
 - 4.1 Precision and accuracy for this method have not been determined.
5. Reference
 - 5.1 The procedure to be used for this determination is found in:
Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 125,
Method 212 (1975).

002071

Approved for NPDES
Issued 1971

170.1-1

XII-6

OXYGEN, DISSOLVED

Method 360.1 (Membrane Electrode)

STORET NO. 00299

1. Scope and Application
 - 1.1 The probe method for dissolved oxygen is recommended for those samples containing materials which interfere with the modified Winkler procedure such as sulfite, thiosulfate, polythionate, mercaptans, free chlorine or hypochlorite, organic substances readily hydrolyzed in alkaline solutions, free iodine, intense color or turbidity and biological flocs.
 - 1.2 The probe method is recommended as a substitute for the modified Winkler procedure in monitoring of streams, lakes, outfalls, etc., where it is desired to obtain a continuous record of the dissolved oxygen content of the water under observation.
 - 1.3 The probe method may be used as a substitute for the modified Winkler procedure in BOD determinations where it is desired to perform nondestructive DO measurements on a sample.
 - 1.4 The probe method may be used under any circumstances as a substitute for the modified Winkler procedure provided that the probe itself is standardized against the Winkler method on samples free of interfering materials.
 - 1.5 The electronic readout meter for the output from dissolved oxygen probes is normally calibrated in convenient scale (0 to 10, 0 to 15, 0 to 20 mg/l for example) with a sensitivity of approximately 0.05 mg/liter.
2. Summary of Method
 - 2.1 The most common instrumental probes for determination of dissolved oxygen in water are dependent upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with DO concentrations. Interfacial dynamics at the probe-sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence should be constant.
3. Sample Handling and Preservation
 - 3.1 See 4.1, 4.2, 4.3, 4.4 under Modified Winkler Method (360.2).
4. Interferences
 - 4.1 Dissolved organic materials are not known to interfere in the output from dissolved oxygen probes.
 - 4.2 Dissolved inorganic salts are a factor in the performance of dissolved oxygen probe.
 - 4.2.1 Probes with membranes respond to partial pressure of oxygen which in turn is a function of dissolved inorganic salts. Conversion factors for seawater and brackish waters may be calculated from dissolved oxygen saturation versus salinity data. Conversion factors for specific inorganic salts may be developed experimentally.

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Issued 1971

360.1-1

XII-7

Broad variations in the kinds and concentrations of salts in samples can make the use of a membrane probe difficult.

4.3 Reactive compounds can interfere with the output or the performance of dissolved oxygen probes.

4.3.1 Reactive gases which pass through the membrane probes may interfere. For example, chlorine will depolarize the cathode and cause a high probe-output. Long-term exposures to chlorine will coat the anode with the chloride of the anode metal and eventually desensitize the probe. Alkaline samples in which free chlorine does not exist will not interfere. Hydrogen sulfide will interfere with membrane probes if the applied potential is greater than the half-wave potential of the sulfide ion. If the applied potential is less than the half-wave potential, an interfering reaction will not occur, but coating of the anode with the sulfide of the anode metal can take place.

4.4 Dissolved oxygen probes are temperature sensitive, and temperature compensation is normally provided by the manufacturer. Membrane probes have a temperature coefficient of 4 to 6 percent/°C dependent upon the membrane employed.

5. Apparatus

5.1 No specific probe or accessory is especially recommended as superior. However, probes which have been evaluated or are in use and found to be reliable are the Weston & Stack DO Analyzer Model 30, the Yellow Springs Instrument (YSI) Model 54, and the Beckman Fieldlab Oxygen Analyzer.

6. Calibration

Follow manufacturer instructions.

7. Procedure

Follow manufacturer instructions.

8. Calculation

Follow manufacturer instructions.

9. Precision and Accuracy

Manufacturer's specification claim 0.1 mg/l repeatability with $\pm 1\%$ accuracy.

Bibliography

1. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 450, Method 422F (1975).

002073